Modernising Scientific Careers Programme

MSc in CLINICAL SCIENCE

(Blood Sciences)

Learning Outcomes
and
Indicative Content
2010/11

Modernising Scientific Careers

Science in healthcare DRIVING A MODERN NHS

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Section A: MSc Curriculum

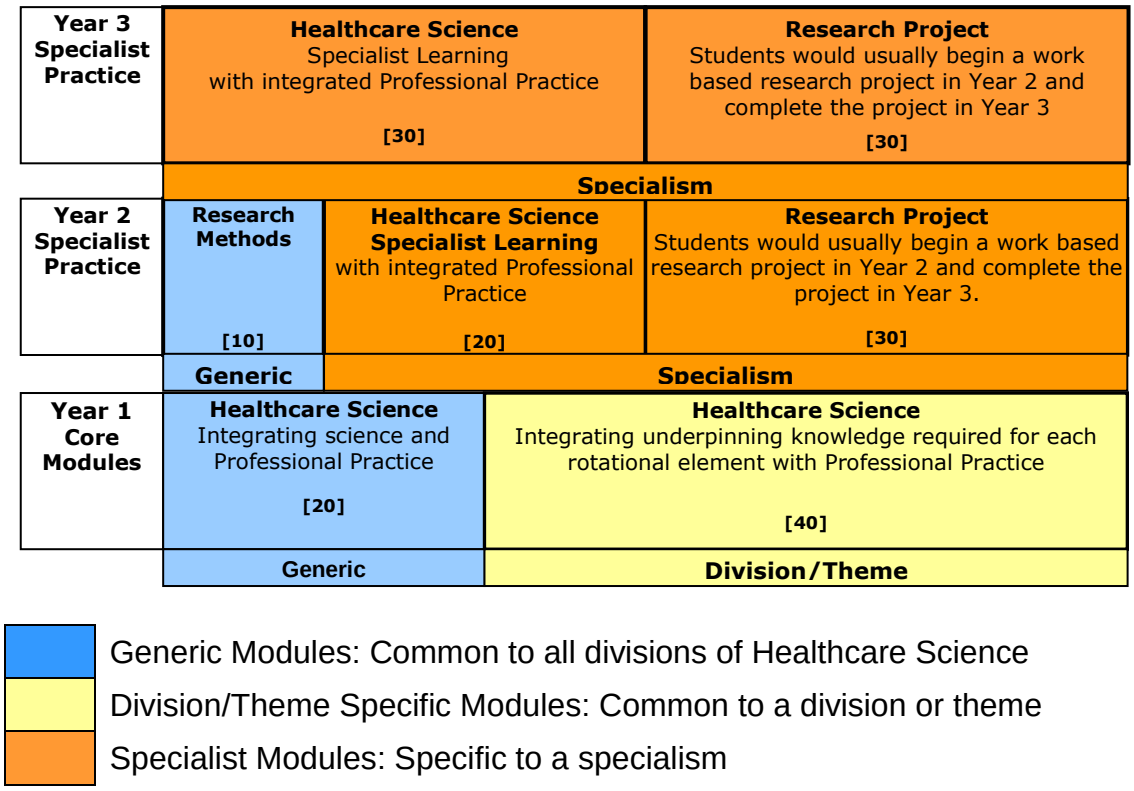
1.0 Background

This document sets out the proposed structure, high level learning outcomes and indicative content for the 3-year, part-time Masters in Clinical Science, that forms part of the Scientist Training Programme (STP). The programme combines and integrates the generic professional practice learning, generic learning in Healthcare Science and Research, theme specific (Blood Sciences) learning and four specialisms namely Clinical Biochemistry, Haematology and Transfusion Science, Clinical Immunology and Genetics.

The diagram below depicts the broad framework around which all Masters programmes must be structured. However, each division within the Modernising Scientific Careers Programme (MSC) has interpreted and adapted this framework.

1.1 High level MSc framework

HIGH LEVEL FRAMEWORK
MSc IN CLINICAL SCIENCE



Generic Modules: Common to all divisions of Healthcare Science

Division/Theme Specific Modules: Common to a division or theme

Specialist Modules: Specific to a specialism

1.2 Blood Sciences Route Map

Blood Sciences will offer an MSc in four specialisms namely:

1. Clinical Biochemistry
2. Haematology and Transfusion Science
3. Clinical Immunology, with an additional variation to support training in Histocompatibility and Immunogenetics
4. Genetics

The route map overleaf shows how the high-level framework has been interpreted for Blood Sciences.

Blood Sciences Route Map

Route map of STP in Blood Sciences with specialism in Clinical Biochemistry, Haematology and Transfusion Sciences, Clinical Immunology or Genetics.
In Year 1, trainees begin by following a generic curriculum across the whole of the STP Training Programme (blue) together with some division-specific modules (yellow).
In Year 2, trainees start to specialise (orange) and by Year 3 the entire curriculum is focused on their chosen specialism.

Year 1	Year 2	Year 3
Healthcare Science [20]	Research Methods [10]	
Introduction to Blood Sciences -- underpinning knowledge for rotational elements [40]		
	Blood Sciences (Clinical Biochemistry)	
	Clinical Disorders of the Major Organs and Cancer [10]	Nutrition [10]
	Endocrinology and Diabetes [10]	Drug Investigation [10]
	Research Project [30]	Pregnancy, Neonatal and Paediatric Clinical Biochemistry [10]
	OR	Research Project [30]
	Blood Sciences (Haematology and Transfusion)	
	Clinical Haematology [10]	Haemostasis [10]
	Transfusion 1[10]	Haemato-oncology [10]
	Research Project [30]	Transfusion 2 [10]
	OR	Research Project [30]
	Blood Sciences (Clinical Immunology)	
	Immunity: Implications for Infection and for Cancer [10]	Hypersensitivity and Allergy [10]
	Immunodeficiency and Immunotherapy [10]	Haematological Malignancies & Transplantation[10]
	Research Project [30]	Autoimmunity [10]
	OR	Research Project [30]
	Blood Sciences (Genetics)	
	Genetics of Learning Disorders [10]	Infertility and Disorders of Sexual Differentiation [10]
	Genetics of Neuromuscular Disorders [10]	Population Screening[10]
	Research Project [30]	Cancer [10]
		Research Project [30]

Credits

Generic	**20**	**10**	**0**
Division/Theme	**40**	**0**	**0**
Specialism		**50**	**60**
Total	**60**	**60**	**60**

2.0 Generic Modules

Within the Scientist Training Programme (STP) the generic curriculum contains two modules namely Healthcare Science and Research Methods.

Professional Practice is also generic and should be integrated across the 3 year STP programme. For further information please see Section B.

2.1 Healthcare Science

Year 1: Generic Module
Healthcare Science [20 credits]

The overall aim of this introductory module is to provide trainees with knowledge and understanding of the basic science and scientific knowledge that will underpin study in any of the three divisions of healthcare science namely Life Sciences, Physical Sciences and Biomedical Engineering and Physiological Sciences within the Scientist Training Programme. This module will also introduce the frameworks underpinning professional practice across the divisions providing the building blocks for future development of professional practice in the workplace.

This module will build on the knowledge, skills and experience gained during undergraduate studies with learning developed and applied further in division and specialism specific modules.[1]

Learning Outcomes: Knowledge and Understanding

On successful completion of this module the trainee will:

1. Outline the chemical, cellular and tissue level of organisation of the body.
2. Describe the function of blood as a tissue, blood cells (types and life times).
3. Know the structure and function of the skin.
4. Know the structure and function of the skeletal system.
5. Describe the organisation, basic structure and function of the central, peripheral and autonomic nervous system.
6. Know the normal structure and function of the respiratory system including ventilation, gaseous exchange and blood gas transport.
7. Know the normal structure and function of the heart, blood vessels and lymphatic system.
8. Know the anatomy and physiology of vision, hearing and equilibrium.
9. Know the normal structure and function of the GI tract including digestion and absorption of food, the liver and liver function tests.
10. Know the normal structure and function of the kidney including anatomy and function of the endocrine system, electrolyte and acid-base balance and hormonal mechanisms and control.

[1] *This module should build on the knowledge gained during undergraduate studies with learning developed further in division and specialism specific modules*

11. Know the anatomy and physiology of the male and female reproductive tract.
12. Know the principles of inheritance, DNA and genetics including carrier status, genetic crosses/pedigree/punnet squares/cross diagrams.
13. Know the cellular, tissue and systems responses to disease including cell death, inflammation, neoplasia, hypertrophy, hyperplasia, tissue responses to injury and repair.
14. Explain how factors affecting health may contribute to inequalities in health between populations.
15. Explain the basic concepts underpinning health economics and their applicability to healthcare science.
16. Know the basis of health protection including principles of surveillance.
17. Examine patients' responses to illness and treatment and consider the impact of psychological and social factors, including culture, on health and health-related behaviour.
18. Know the basic principles of physics that underpin healthcare science e.g. ultrasound, radiation
19. Explain the structures and processes that underpin quality assurance including quality control, assurance, quality improvement and clinical governance.
20. Know and apply basic principles of communication with respect to key features of effective patient interviews and information giving; working with groups of the population who have particular communication needs such as children, those with learning disabilities and management of emotional responses within the scientist-patient interaction.
21. Know the basic principles and structures underpinning history taking and clinical examination.
22. Know and understand the importance of the concept of shared leadership and the associated personal qualities and behaviours that promote shared leadership.
23. Understand the structure and management of health and social care services and the management of local healthcare systems in the United Kingdom.

Learning Outcomes: Associated Personal Qualities and Behaviours (Professionalism)

On successful completion of this module the trainee will:

1. Respect and understand individuals' beliefs and ways of coping with illness.
2. Demonstrate knowledge of the influence of culture and beliefs on health.
3. Apply a range of study skills including time management, organisational skills, using the library, search engines, self-directed learning, reflective practice and critical analysis during this introductory module.
4. Demonstrate communication skills by listening to others, taking other viewpoints into consideration, giving effective feedback, receiving and responding to feedback and working in a team.

Indicative Content

- Review of the organisation, structure and function of the body
- Review of basic genetic concepts
- Review of the pathological processes underpinning common diseases:
    - Cell death
    - Inflammation
    - Neoplasia
    - Hypertrophy
    - Hyperplasia
    - Tissue response to injury and repair
- Factors affecting health and their contribution to inequalities in health between populations
- Basis of health protection including principles of surveillance
- Patients' responses to illness and treatment including the impact of psychological, social factors and culture
- Basic principles of physics underpinning common techniques used in healthcare science e.g. ultrasound, radiation
- Basic principles of quality assurance including quality control, assurance, quality improvement and clinical governance.
- Health economics
- Communications skills
- Introduction to history taking and clinical examination
- Introduction to Leadership within the NHS
- Introduction to the structure of the NHS

2.2 Research Methods

Year 2: Generic Module
Research Methods [10 credits]

The overall aim of this module is to ensure that the trainee has the underpinning knowledge of the importance of research, development and innovation across the NHS and in healthcare science in particular and to provide the underpinning knowledge for the research project.

Learning Outcomes: Knowledge and Understanding

On successful completion of this module the trainee will:

1. Explain the context within which research and audit are undertaken within the NHS.
2. Examine the contribution of the Healthcare Science workforce to undertaking cutting edge translational research for patient benefit and promoting innovation within the NHS.
3. Differentiate between audit and research and know different types of research approaches including qualitative, quantitative and systematic review.
4. Know the processes that underpin clinical trials and their potential value, risks and benefits.
5. Explain how to formulate a research question and design a project.

6. Explain the current ethical and governance frameworks within which human and animal work can be conducted in the UK.
7. Know current ethical approval processes for research and audit, the requirements for continuous monitoring, progress reporting, adverse event monitoring, study closure and archiving.
8. Describe the role of peer review and user involvement in research design.
9. Appraise research and research proposals with respect to costs and benefits
10. Explain the application of common statistical techniques for dealing with data.
11. Explain a range of methods to disseminate research findings and discuss the advantages and disadvantages of each method.
12. Describe how clinical guidelines are produced and the concept of evidence based practice including the role of current statutory and advisory regulatory bodies.
13. Explain the processes for quality assurance in research, audit and service improvement.
14. Describe the potential sources of research funding for Healthcare Science research and basic principles of Intellectual Property regulations.
15. Discuss how the findings of research and audit can be used to improve the practice of healthcare science and improve patient care and service delivery.

Learning Outcomes: Practical Skills

On successful completion of this module the trainee will:

1. Generate a research question.
2. Critically review the literature to establish current knowledge with respect to the research question and summarise the findings.
3. Identify and discuss an audit project that has resulted in change specific to their specialism.
4. Identify and discuss a research study that has resulted in an improvement in patient care relevant to their specialism.

Learning Outcomes: Associated Personal Qualities and Behaviours (Professionalism)

On successful completion of this module the trainee will:

1. Demonstrate effective oral communication skills including the ability to present scientific data to non-scientists.
2. Demonstrate effective organisation skills.
3. Identify how innovation will have a positive impact on the practice of healthcare science.

Indicative Content

- Good Clinical Practice
- Research ethics and clinical governance
- Research method including:
    - Qualitative
    - Quantitative
    - Bio-statistical
    - Systematic review
    - Epidemiological research methods
- Study design
- Hypothesis generation and testing
- Literature searching and referencing
- Critical appraisal
- Evidence based practice
- Application and interpretation of statistical techniques
- Dissemination of research/audit findings
- Development of clinical guidelines
- Quality assurance applied to research
- Cost-benefit of research

3.0 Division/Theme Specific Modules

3.1 Introduction to Blood Sciences

This section covers the division/theme specific modules that will be studied by all trainees undertaking the Blood Science programme.

Division: Life Sciences
Theme: Blood Sciences
Year 1: Introduction to Blood Sciences [40 credits]

The overall aim of this module is to provide the trainee with the knowledge that underpins the rotations in the first twelve months of the Blood Sciences STP and the common learning required within the division. The 40 credit module may conveniently be considered as four specialisms focussed rotational modules of equal length.

Division: Life Sciences
Theme: Blood Sciences
Year 1: Introduction to Blood Sciences [40 credits in total]

- **Clinical Biochemistry Rotation: CB-1: Investigation of Major Organ Function [10 credits]**
- **Haematology and Transfusion Science Rotation: HT-1: Introduction to Haematology and Transfusion Science [10 credits]**
- **Clinical Immunology Rotation: CI-1: Immunity and the Principles and Practise of Clinical Immunology [10 credits]**
- **Genetics Rotation: CG-1: Genetics and Molecular Science [10 credits]**

Training capacity may be an issue in Clinical Immunology and Genetics. Therefore, the rotational modules in these specialisms have been designed so that trainees can complete them without having to spend a full three months in a specialist laboratory. Work based experience in areas of Clinical Biochemistry and Haematology and Transfusion Science are relevant.

Clinical Biochemistry Rotation [10 credits]
CB-1: Investigation of Major Organ Function

This module will provide the trainee with the knowledge and understanding of the normal physiology of the major organs and the biochemical parameters in common use for the investigation and management of major organ dysfunction. They will perform common methods used in the investigation of major organ function and gain experience of the interpretation of patient results in a variety of clinical settings.

Learning Outcomes: Knowledge and Understanding

On successful completion of this module the trainee will:

1. Understand normal physiological homeostasis of the major organs.
2. Understand the pathophysiology and cause of common disorders of the major organs.
3. Explain the presentation, diagnosis and management of common biochemical disorders of major organ function.
4. Understand the principles of common biochemical measurement techniques used to investigate major organ function.
5. Describe the design, operation and performance of automated analytical platforms used to investigate major organ function.
6. Describe the design, operation and performance of point of care testing devices supported by the clinical biochemistry laboratory.
7. Understand the biochemical investigation of major organ disease in the patient pathway, the correct sampling technique and the use and validity of reference ranges.
8. Understand the principles of internal quality control (IQC) and external quality assessment (EQA).
9. Understand the use of laboratory information technology (IT) systems for handling, processing and storage of patient data.
10. Describe the partnership of clinical biochemistry to other clinical specialisms in the investigation of disorders of major organs.

Learning Outcomes: Associated Work Based Learning

High level description of the work based learning that accompanies this academic module. Further details are contained within the work based training manual.

On successful completion of this module the trainee will:

1. Gain experience of the biochemical investigation of major organ disease in the patient pathway, the correct sampling technique and the use and validity of reference ranges.
2. Understand and demonstrate the ability to perform the range of laboratory and point of care techniques used in the workplace to investigate major organ function.
3. Demonstrate the ability to apply the principles of internal quality control and external quality assessment and draw conclusions about assay performance.
4. Demonstrate the ability to use laboratory IT systems for handling, processing and storage of patient data.
5. Gain experience of the interpretation and reporting of laboratory results in the context of common clinical disorders.
6. Gain experience of the partnership of clinical biochemistry to other clinical specialisms in the investigation of disorders of major organs.

Learning Outcomes: Associated Personal Qualities and Behaviours (Professionalism)

On successful completion of this module the trainee will, in the context of clinical biochemistry:

1. Present complex ideas in simple terms in both oral and written formats.
2. Consistently operate within sphere of personal competence and level of authority.
3. Manage personal workload and objectives to achieve quality of care.
4. Actively seek accurate and validated information from all available sources.
5. Select and apply appropriate analysis or assessment techniques and tools.
6. Evaluate a wide range of data to assist with judgements and decision making.
7. Conduct a suitable range of diagnostic, investigative or monitoring procedures with due care for the safety of self and others.
8. Report problems and may take part in restorative action within quality control/assurance requirements to address threats of performance deterioration.
9. Work in partnership with colleagues, other professionals, patients and their carers to maximise patient care.

Indicative Content

- The normal physiology and function of the following major organs: kidney, liver, heart, lungs, bone and pancreas. To include water homeostasis and acid base balance
- The clinical and scientific basis of common biochemical markers of function of the kidney, liver, heart, lungs, bone and pancreas
- The application of common biochemical markers of major organ function to a range of frequently encountered clinical disorders
- Presentation, diagnosis and management of common clinical biochemical disorders of major organ function
- The biological and statistical basis of biological variation, reference values and action limits
- Principles and practice of IQC) and EQA
- Scientific basis of the following techniques: spectrophotometry, osmometry, ion selective electrodes, enzymology, immunochemical techniques, electrophoresis, chromatography, and solid phase chemistry
- Design, operation and performance of automated analytical platforms, including random access, modular, robotics etc
- Design, operation and performance of point of care testing devices supported by the clinical biochemistry laboratory

Haematology and Transfusion Science Rotation [10 credits]
HT-1: Introduction to Haematology and Transfusion Science

This module will provide the trainee with the knowledge and understanding of the formation of blood cells, the mechanism of haemostasis and the relevance of blood group antigens and antibodies. They will understand the principles and practice of common methods used in haematology, haemostasis and blood transfusion and perform some of them in the laboratory. They will understand common clinical disorders associated with abnormal haematology and haemostasis and gain experience of the interpretation of patient results in a variety of clinical settings. They will gain knowledge of blood transfusion in a variety of settings, and understand how to provide patients with safe and effective transfusion support.

Learning Outcomes: Knowledge and Understanding

On successful completion of this module the trainee will:

1. Understand the haemopoeitic pathways.
2. Describe the design, operation and performance of the routine tests used in screening and investigating haematological disorders and their normal limits.
3. Understand normal haemostatic mechanisms, and disorders causing bleeding or thrombosis.
4. Describe the design, operation and performance of the tests used to investigate disorders of haemostasis.
5. Understand the concept of blood groups and the application of blood group serology in establishing compatibility between patient and donor.
6. Describe the design, operation and performance of the tests and procedures required to enable selection of safe and appropriate blood and blood components for patients with a range of clinical conditions.
7. Know the range of blood components and products in common use and understand the importance of correct storage.
8. Be aware of legislation and guidance relevant to blood transfusion practice.
9. Describe the partnership of haematology and transfusion science to other clinical specialisms in the investigation and management of common disorders.

Learning Outcomes: Associated Work Based Learning

High level description of the work based learning that accompanies this academic module. Further details are contained within the work based training manual.

On successful completion of this module the trainee will:

1. Gain experience of the scope of the hospital haematology laboratory in the investigation of basic haematological disorders, haemostasis and

blood transfusion.
2. Gain experience of the investigation of basic haematological disorders, the correct sampling technique and the use and validity of reference ranges.
3. Understand and demonstrate the ability to perform the range of laboratory techniques used in screening and investigating haematological disorders.
4. Gain experience of the investigation of disorders of haemostasis.
5. Understand and demonstrate the ability to perform the range of laboratory and point of care techniques used in the investigation of disorders of haemostasis.
6. Demonstrate the ability to perform blood group serology in the context of pre-transfusion testing
7. Demonstrate the ability to select safe and appropriate blood and blood components for patients with a range of clinical conditions
8. Gain experience of the range of blood components and products in common use and their correct storage.
9. Demonstrate the ability to apply the principles of internal quality control and external quality assessment and draw conclusions about assay performance.
10. Demonstrate the ability to use laboratory IT systems for handling, processing and storage of patient data.
11. Gain experience of the interpretation and reporting of laboratory results in the context of common clinical disorders.
12. Gain experience of the partnership of haematology and transfusion science to other clinical specialisms in the investigation and management of common disorders.

Learning Outcomes: Associated Personal Qualities and Behaviours (Professionalism)

On successful completion of this module the trainee will, in the context of haematology and transfusion science:

1. Present complex ideas in simple terms in both oral and written formats.
2. Consistently operate within sphere of personal competence and level of authority.
3. Manage personal workload and objectives to achieve quality of care.
4. Actively seek accurate and validated information from all available sources.
5. Select and apply appropriate analysis or assessment techniques and tools.
6. Evaluate a wide range of data to assist with judgements and decision making.
7. Conduct a suitable range of diagnostic, investigative or monitoring procedures with due care for the safety of self and others.
8. Report problems and may take part in restorative action within quality control/assurance requirements to address threats of performance deterioration.
9. Work in partnership with colleagues, other professionals, patients and their carers to maximise patient care.

Indicative Content

- Normal haemopoiesis and bone marrow function in the development and differentiation of blood cells
- Normal haemostasis and its components. Role of the liver in the production of coagulation factors
- Principles, scientific basis and clinical application of commonly performed analytical procedures in haematology
- Principles and scientific basis of automated coagulation analysers and point of care instruments in the assessment of coagulation function
- Principles and scientific basis of automated cell counters and point of care instruments for numeration and identification of cellular blood components
- Point of care testing in haematology
- Presentation, diagnosis and management of common haematological disorders
- The establishment, application and limitations of biological normal reference ranges including age, ethnic and sex related reference ranges
- Bone marrow aspiration, trephine biopsy, preparation and staining techniques for the morphological identification of cells in bone marrow in normal and pathological conditions.
- Blood film preparation, staining and interpretation in normal and pathological conditions including parasites
- Principles and application of internal quality control and external quality assurance programmes
- Basic blood group systems - genes, antigens and antibodies
- Manual and automated techniques for ABO/D typing, serological crossmatching, red cell phenotyping, antibody screening and identification
- Overview of blood transfusion services and range of blood components / products manufactured and their applications
- Principles of pre-transfusion testing
- Normal ranges and predictive values for pathology tests used to inform transfusion support
- Aetiology and clinical features of conditions requiring transfusion support
- Overview of legislation / guidelines relevant to blood transfusion practice

Clinical Immunology Rotation [10 credits]
CI-1: Immunity and the Principles and Practice of Clinical Immunology

This module will provide the trainee with an introduction to the immune system and immune responses. They will understand the organisation and delivery of a clinical immunology laboratory service. They will perform some common methods used in clinical immunology and gain an understanding of the interpretation of patient results in a variety of clinical settings.

Learning Outcomes: Knowledge and Understanding

On successful completion of this module the trainee will:

1. Understand the function of the immune system in health.
2. Know and understand the function of the major cells of the immune

system.
3. Know and understand the function of the major humoral components of the immune response.
4. Understand the innate immune system.
5. Understand the adaptive immune response.
6. Understand the co dependence of the innate and adaptive immune systems.
7. Describe the design, operation and performance of the tests and assays used within clinical immunology.
8. Describe the partnership of clinical immunology to other clinical specialisms in the investigation and management of disorders of the immune system.

Learning Outcomes: Associated Work Based Learning

High level description of the work based learning that accompanies this academic module. Further details are contained within the work based training manual

On successful completion of this module the trainee will:

1. Gain experience of the investigation of the immune response, correct sampling technique and the use and validity of reference ranges.
2. Gain experience of the role of the immune response in common clinical disorders.
3. Understand and demonstrate the ability to perform the range of laboratory techniques used in the workplace in clinical immunology.
4. Demonstrate the ability to apply the principles of internal quality control and external quality assessment and draw conclusions about assay performance.
5. Demonstrate the ability to use laboratory IT systems for handling, processing and storage of patient data.
6. Gain experience of the interpretation and reporting of laboratory results in the context of common clinical disorders.
7. Gain experience of the partnership of clinical immunology to other clinical specialisms in the investigation and management of disorders of the immune system.

Learning Outcomes: Associated Personal Qualities and Behaviours (Professionalism)

On successful completion of this module the trainee will, in the context of clinical immunology:

1. Present complex ideas in simple terms in both oral and written formats.
2. Consistently operate within sphere of personal competence and level of authority.
3. Manage personal workload and objectives to achieve quality of care.
4. Actively seek accurate and validated information from all available sources.

5. Select and apply appropriate analysis or assessment techniques and tools.
6. Evaluate a wide range of data to assist with judgements and decision making.
7. Conduct a suitable range of diagnostic, investigative or monitoring procedures with due care for the safety of self and others.
8. Report problems and may take part in restorative action within quality control/assurance requirements to address threats of performance deterioration.
9. Work in partnership with colleagues, other professionals, patients and their carers to maximise patient care.

Indicative Content

- Organisation and components of the immune system
    - Cellular components (lymphocytes; granulocytes; monocytes/macrophages)
    - Humoral components (antibodies/immunoglobulins; complement; cytokines)
    - Molecules of the immune system (major histocompatibility molecules class I &II; cluster of differentiation (CD) molecules/cell surface markers; receptor molecules; recognition molecules; adhesion molecules; effector molecules)
    - Antigen presentation
- Innate immune response (endothelial cells; neutrophils; macrophages; natural killer cells; complement)
- Adaptive immune response (antigen processing; dendritic cells; T cell responses; B cell responses; primary and secondary responses; vaccination/immunisation)
- Outcome of immune responses (immunity/immunological memory; inflammation; direct & indirect functions of antibodies; incidental tissue damage; hypersensitivity and allergy)

Genetics Rotation [10 credits]
CG-1: Genetics and Molecular Science

This module will provide the trainee with an introduction to human genetics and molecular science. They will understand the organisation and delivery of a genetics laboratory service. They will perform some common methods used in genetics and gain an understanding of the interpretation of patient results in a variety of clinical settings.

Learning Outcomes: Knowledge and Understanding

On successful completion of this module the trainee will:

1. Understand nucleic acid structure and function.
2. Understand chromosome structure and function.
3. Understand the nomenclature used to describe the human genome.
4. Understand patterns of inheritance.
5. Describe the design, operation and performance of methods used in the investigation of chromosomal abnormality.

6. Describe the design, operation and performance of methods used to investigate the molecular basis of disease.
7. Describe the partnership of genetics to other clinical specialisms in the investigation of genetic disorders.

Learning Outcomes: Associated Work Based Learning

High level description of the work based learning that accompanies this academic module. Further details are contained within the work based training manual.

On successful completion of this module the trainee will:

1. Gain experience of the investigation of chromosomal abnormality, the correct sampling technique and the use and validity of reference data.
2. Understand and demonstrate the ability to perform laboratory techniques used in the investigation of chromosomal abnormality.
3. Gain experience of the investigation of the molecular basis of disease, the correct sampling technique and the use and validity of reference data.
4. Understand and demonstrate the ability to perform laboratory techniques used in the investigation of the molecular basis of disease.
5. Demonstrate the ability to apply the principles of internal quality control and external quality assessment and draw conclusions about assay performance.
6. Demonstrate the ability to use laboratory IT systems for handling, processing and storage of patient data.
7. Gain experience of the interpretation and reporting of laboratory results in the context of named clinical genetic disorders.
8. Gain experience of the partnership of genetics to other clinical specialisms in the investigation of genetic disorders.

Learning Outcomes: Associated Personal Qualities and Behaviours (Professionalism)

On successful completion of this module the trainee will, in the context of genetics:

1. Present complex ideas in simple terms in both oral and written formats.
2. Consistently operate within sphere of personal competence and level of authority.
3. Manage personal workload and objectives to achieve quality of care.
4. Actively seek accurate and validated information from all available sources.
5. Select and apply appropriate analysis or assessment techniques and tools.
6. Evaluate a wide range of data to assist with judgements and decision making.
7. Conduct a suitable range of diagnostic, investigative or monitoring procedures with due care for the safety of self and others.

8. Report problems and may take part in restorative action within quality control/assurance requirements to address threats of performance deterioration.
9. Work in partnership with colleagues, other professionals, patients and their carers to maximise patient care.

Indicative Content

- Cell biology, meiosis and mitosis, chromosome segregation
- Chromosome structure and function
- Mechanisms of origin of numerical and structural abnormalities, and behaviour of structural chromosome anomalies at meiosis
- Nucleic acid structure and function, chemical structure of DNA and replication, transcription and translation
- Patterns of inheritance – autosomal dominant and recessive, X-linked
- Introduction to the human genome
- Understanding of current Human Genome Variation Society (HGVS) and International System for Human Cytogenetic Nomenclature (ISCN) nomenclature
- Introduction to the molecular basis of disease
- Molecular science methodology
- Laboratory techniques and application of new cytogenetic tests e.g. fluorescent in-situ hybridisation (FISH); comparative genome hybridisation (CGH)
- DNA extraction, polymerase chain reaction (PCR), DNA sequencing, Southern blotting
- RNA extraction; reverse transcription PCR (RT-PCR)
- Application of DNA based testing for gene mapping, linkage and mutation detection
- Sensitivity and specificity of molecular scientific tests
- Potential application of new DNA tests
- Plasma DNA and RNA

4.0 Specialist Modules for Clinical Biochemistry

	Module Titles			
Year 3	CB-4: Nutrition [10]	CB-5: Drug Investigation [10]	CB-6: Pregnancy, Neonatal & Paediatric Clinical Biochemistry [10]	CB-Res: Research Project in Clinical Biochemistry [30]
Year 2	Research Methods [10]	CB-2: Clinical Disorders of the Major Organs and Cancer [10]	CB-3: Endocrinology and Diabetes [10]	CB-Res: Research Project in Clinical Biochemistry [30]
Year 1	Healthcare Science - integrating science and professional practice [20]		Introduction to Blood Sciences - underpinning knowledge for rotational elements and integrated professional practice [40]	

Generic Modules: Common to all divisions of Healthcare Science

Division/Theme Specific Modules: Common to a Division or Theme

Specialist Modules: Specific to a specialism

4.1 Year 2 Specialist Practice

These modules provide the trainee with the knowledge that underpins the specialist module in Clinical Biochemistry and provides trainees with the tools to undertake work based learning.

Division: **Life Sciences**
Theme: **Blood Sciences**
Specialism: **Clinical Biochemistry**
Year 2: **CB-2: Clinical Disorders of the Major Organs and Cancer [10 Credits]**

This module will provide the trainee with detailed knowledge and understanding of the clinical disorders of major organ function, and the clinical and laboratory methods used in diagnosis and management. They will understand the aetiology and biochemical investigation of a range of malignancies. They will gain experience of performing and assuring a range of manual, semi-automated and automated methods used in the investigation of major organ function and cancer. They will gain extensive experience of the interpretation of patient results in a variety of clinical settings.

Learning Outcomes: Knowledge and Understanding

On successful completion of this module the trainee will:

1. Understand the clinical investigation of hydrogen, water, and electrolyte homeostasis and blood gases, and the causes and consequences of abnormal results.
2. Understand and evaluate the function of the kidney in a range of pathological conditions and monitor biochemical parameters controlled by renal replacement therapy.
3. Understand and use liver function tests to differentiate the cause of liver disease, assess the degree of liver damage and/or remaining function in a range of pathological conditions.
4. Understand and differentiate the causes of abnormal cardiac function, assess degree of damage to cardiac tissue and monitor treatment.
5. Understand the process of normal bone modelling/remodelling in health and disease and the investigation of normal and abnormal bone metabolism and calcium homeostasis.
6. Understand the role clinical biochemistry plays in the screening, diagnosis and treatment of common cancers.
7. Understand and the properties and functions of a range of specific proteins in health and disease.
8. Describe the partnership of clinical biochemistry to other clinical specialisms in the investigation of major organ function and cancer.

Learning Outcomes: Associated Work Based Learning

High level description of the work based learning that accompanies this

academic module. Further details are contained within the work based training manual.

On successful completion of this module the trainee will:

1. Demonstrate the ability to perform the range of laboratory and point of care testing techniques used in the workplace to investigate major organ function and cancer.
2. Gain experience of the clinical and laboratory investigation of hydrogen, water, and electrolyte homeostasis and blood gases, including the interpretation and reporting of results in the correct clinical context.
3. Gain experience of the clinical and laboratory investigation of kidney function and renal replacement therapy including the interpretation and reporting of results in the correct clinical context.
4. Gain experience of the clinical and laboratory investigation of liver function including the interpretation and reporting of results in the correct clinical context.
5. Gain experience of the clinical and laboratory investigation of cardiac function in acute and chronic conditions including the interpretation and reporting of results in the correct clinical context.
6. Gain experience of the clinical and laboratory investigation of disorders of calcium homeostasis and metabolic bone disease including the interpretation and reporting of results in the correct clinical context.
7. Gain experience of the application of clinical biochemistry to the screening, diagnosis and treatment of common cancers including the interpretation and reporting of results in the correct clinical context.
8. Gain experience of the clinical and laboratory investigation of disorders associated with specific protein abnormalities including the interpretation and reporting of results in the correct clinical context.
9. Gain experience of the partnership of clinical biochemistry to other clinical specialisms in the investigation of major organ function and cancer.

Learning Outcomes: Associated Personal Qualities and Behaviours (Professionalism)

On successful completion of this module the trainee will, in the context of clinical biochemistry:

1. Present complex ideas in simple terms in both oral and written formats.
2. Consistently operate within sphere of personal competence and level of authority.
3. Manage personal workload and objectives to achieve quality of care.
4. Actively seek accurate and validated information from all available sources.
5. Select and apply appropriate analysis or assessment techniques and tools.
6. Evaluate a wide range of data to assist with judgements and decision making.
7. Conduct a suitable range of diagnostic, investigative or monitoring procedures with due care for the safety of self and others.
8. Report problems and take part in restorative action within quality

control/assurance requirements to address poor performance.
9. Interpret data and convert into knowledge for use in the clinical context of individual and groups of patients.
10. Work in partnership with colleagues, other professionals, patients and their carers to maximise patient care.

Indicative Content

- Water and electrolytes: Distribution of fluid and electrolytes; renin angiotensin aldosterone system, antidiuretic hormone, natriuretic peptides, hyper- and hypovolaemia; hyper- and hyponatraemia; hyper- and hypokalaemia; metabolic effects of trauma/stress/surgery; principles of i.v. fluid replacement therapy
- Renal function: Assessment of glomerular function; salt and water homeostasis; hydrogen ion homeostasis; uraemia; definition and assessment of acute kidney injury; definition and assessment of chronic renal failure; renal replacement therapy; renal transplantation; renal tubular acidosis; renal stones
- Liver function: Formation of bilirubin; enterohepatic circulation and bile salts; jaundice; hepatitis; cirrhosis; haemochromatosis; alcohol/drug hepatotoxicity; fatty liver disease; Wilson's disease; cholestasis; biliary obstruction; gall stones; hepatoma; liver transplantation
- Cardiac function: Apolipoproteins and cholesterol metabolism; Hyperlipidaemia; atheroma; acute coronary syndromes; chronic heart failure; hypertension; cardiovascular risk stratification; primary and secondary cardiovascular disease prevention
- Lung function: Respiratory and renal mechanisms in acid base balance; acidosis; alkalosis; tissue oxygenation; acute and chronic respiratory disease
- Bone function: Structure and function of bone; calcium and magnesium homeostasis; vitamin D; hyper- and hypocalcaemia; disorders of phosphate; disorders of magnesium; rickets and osteomalacia; osteoporosis; Paget's disease; renal osteodystrophy
- Cancer: Causes of malignancy; tumour growth and metastasis; molecular basis of malignancy; blood and urinary tumour markers of breast, lung, prostate, ovarian, testicular, pancreatic, GI tract, bladder, thyroid cancer; tissue based tumour markers; tumour related effects of malignancy. NHS bowel cancer screening programme
- Proteins: Properties and functions of albumin, transport proteins, protease inhibitors; ceruloplasmin, immunoglobulins, CRP, cytokines; hyper- and hypoalbuminaemia; paraproteinaemia; cryoglobulinaemia; alpha 1 anti-trypsin deficiency; plasmapheresis

Division: **Life Sciences**
Theme: **Blood Sciences**
Specialism: **Clinical Biochemistry**
Year 2: **CB-3: Endocrinology and Diabetes**
[10 Credits]

This module will provide the trainee with the knowledge and understanding of the normal physiology and pathophysiology of the major endocrine organs in the body. They will appreciate the importance of clinical and biochemical parameters in diagnosing, assessing the response to treatment and monitoring patients with common endocrine disorders. They will perform endocrine assays using a range of methods and gain experience of the interpretation of hormone results in common endocrine conditions.

Learning Outcomes: Knowledge and Understanding

On successful completion of this module the trainee will:

1. Understand, compare and contrast the synthesis, secretion, metabolism and modes of action of hormones.
2. Describe the use of negative feedback systems and dynamic function tests to differentiate primary and secondary endocrine disorders.
3. Understand how to derive appropriate reference ranges and describe the importance of biological variation when interpreting hormone results.
4. Understand the clinical and laboratory investigation of a wide range of endocrine disorders.
5. Describe the design, operation and performance of the range of methods used in the measurement of hormones.
6. Understand and identify when interference can invalidate the validity of the result.
7. Understand the causes, classification and investigation of diabetes mellitus.
9. Describe the design, operation and performance of the range of laboratory and point of care methods used in the screening, diagnosis and monitoring of diabetes mellitus.
10. Describe the partnership of biochemical endocrinology to other clinical specialisms in the investigation of endocrine disorders and diabetes.

Learning Outcomes: Associated Work Based Learning

High level description of the work based learning that accompanies this academic module. Further details are contained within the work based training manual.

On successful completion of this module the trainee will:

1. Understand and demonstrate the ability to perform the range of laboratory and point of care techniques used in the workplace to investigate

endocrine disorders and diabetes.
2. Gain experience of the clinical and laboratory investigation and management of the following endocrine disorders including the interpretation and reporting of results in the correct clinical context:
    - Pituitary disorders
    - Thyroid disorders
    - Ovarian and testicular disorders
    - Adrenal disorders
    - Endocrine disorders of calcium metabolism
    - Endocrine disorders of the gastrointestinal tract
    - Endocrine causes of obesity
3. Gain experience of the clinical and laboratory investigation and management of diabetes mellitus including the interpretation and reporting of results in the correct clinical context.
4. Gain experience of the partnership of biochemical endocrinology to other clinical specialisms in the investigation of endocrine disorders and diabetes.

Learning Outcomes: Associated Personal Qualities and Behaviours (Professionalism)

On successful completion of this module the trainee will, in the context of clinical biochemistry:

1. Present complex ideas in simple terms in both oral and written formats.
2. Consistently operate within sphere of personal competence and level of authority.
3. Manage personal workload and objectives to achieve quality of care.
4. Actively seek accurate and validated information from all available sources.
5. Select and apply appropriate analysis or assessment techniques and tools.
6. Evaluate a wide range of data to assist with judgements and decision making.
7. Conduct a suitable range of diagnostic, investigative or monitoring procedures with due care for the safety of self and others.
8. Report problems and take part in restorative action within quality control/assurance requirements to address poor performance.
9. Interpret data and convert into knowledge for use in the clinical context of individual and groups of patients.
10. Work in partnership with colleagues, other professionals, patients and their carers to maximise patient care.

Indicative Content

- Basic endocrinology, hormones and hormone action
- Methods used for measuring hormones in biological samples
- Biological variability and its impact on reference values in endocrinology
- Normal physiology and pathophysiology of
    - The pituitary gland (anterior and posterior)

    - The thyroid gland
    - The gonads (ovaries and testes)
    - The adrenal glands
    - The parathyroid glands
    - The pancreas
    - Adipose tissue
- Clinical and biochemical parameters for the diagnosis, treatment and monitoring of:
    - Pituitary disorders
    - Thyroid disorders
    - Ovarian and testicular disorders
    - Adrenal disorders
    - Endocrine disorders of calcium metabolism
    - Endocrine disorders of gastrointestinal function
    - Endocrine causes of obesity
- Causes and classification of diabetes mellitus
- Clinical and biochemical parameters for the screening, diagnosis, treatment and monitoring of diabetes mellitus
- New developments in endocrinology

4.2 Year 2 and 3 Research Project

Division:	**Life Sciences**
Theme:	**Blood Sciences**
Specialism:	**Clinical Biochemistry**
Year 2 and 3:	**CB-Res: Research Project in Clinical Biochemistry [60 Credits]**

The overall aim of this module, building on the Research Methods module is for the trainee to undertake research that shows originality in the application of knowledge, together with a practical understanding of how established techniques of research and enquiry are used to create and interpret new information in a specialism of healthcare science. During Years 2 and 3 the trainee will undertake an original piece of research involving the application of scientific investigation to one or more clinical situations. The trainee will also be expected to complete three shorter health services research projects to gain an understanding of the health services contexts within which clinical research is undertaken.

One each in:

- Evidence-based practice
- Clinical audit
- Supporting professional service users

Learning Outcomes: Knowledge and Understanding

On successful completion of this module the trainee will:

1. Evaluate the basic scientific principles underpinning research.
2. Critically evaluate the principles and practice of evidence based medicine.

3. Explain and critically evaluate individual research publications according to evidence based medicine criteria.
4. Critically evaluate, analyse and summarise current research and advanced scholarship in the specialism and draw justified conclusions from the evidence.
5. Explain the current system of grading research publications.
6. Explain the use and limitations of reference manager systems.
7. Describe and appraise the process leading to publication of a research paper.
8. Describe the audit cycle and the importance of clinical audit in improving patient care, multidisciplinary working and in optimising laboratory medicine service provision.
9. Recognise the importance of innovation in healthcare science.

Learning Outcomes: Associated Work Based Practical Skills

On successful completion of this module the trainee will:

1. Establish the core skills necessary for scientific research in a clinical environment.
2. Develop and propose a hypothesis.
3. Undertake a research project to test the hypothesis from conception to completion.
4. Confirm the necessary ethical, audit and/or Research and Development (R&D) approval.
5. Assemble a body of data and analyse the data using appropriate statistical techniques.
6. Prepare a written project report that analyses the findings and identifies strengths and weaknesses of the research project.
7. Communicate knowledge or arguments from the research project both orally and in writing including presentation at a work based meeting.
8. Critically evaluate and draw conclusions about the quality of relevant research publications.
9. Contribute to and take an active part in the performance of a clinical audit that involves completion of the audit cycle.
10. Demonstrate the importance of multidisciplinary working in the design, delivery and optimisation of improved laboratory medicine services.

Learning Outcomes: Associated Personal Qualities and Behaviours (Professionalism)

On successful completion of this module the trainee will:

1. Further develop critical analytical skills.
2. Evaluate and apply evidence.
3. Work within an ethical framework.
4. Work independently or as a member of a team.
5. Demonstrate effective time management and organisation.
6. Exercise initiative and personal responsibility.
7. Reflect on performance and seek help and advice when necessary.

Indicative Content

- Literature searching
- Principles and good practice examples of evidence based medicine
- The audit cycle and its good practice examples of its application to clinical audit as a means of service development
- Critical analysis
- Research project that may include:
    - Systematic review
    - Evaluation of new methodologies
    - Investigation to improve performance of a method
    - Evaluation of new/modified quality assurance of a method
    - Audit of method performance across a range of departments
    - Critical analysis of evidence-base underpinning a specified procedure
- Communications skills
- Report writing
- Presentation skills

4.3 Year 3 Specialist Practice

Division: **Life Sciences**
Theme: **Blood Sciences**
Specialism: **Clinical Biochemistry**
Year 3: **CB-4: Nutrition [10 Credits]**

This module will provide the trainee with the knowledge and understanding of normal nutrition and clinical disorders associated with malnutrition, malabsorption and obesity. Trainees will understand the normal biochemistry of haem synthesis, haematinics and contribute to the investigation of anaemia. They will be able to describe the role of trace elements and vitamins and clinical conditions associated with deficiency or excess. They will be able to assess energy balance and understand enteral and parenteral nutrition. They will appreciate the importance of clinical and biochemical parameters in diagnosing and managing nutritional disorders. They will perform assays to assess nutritional status using a range of methods and gain experience of the interpretation of results in a range of clinical conditions.

Learning Outcomes: Knowledge and Understanding

On successful completion of this module the trainee will:

1. Understand the need for macro and micronutrients for normal health, growth, repair and reproduction.
2. Understand the role of clinical biochemistry in the assessment of nutritional status, (including that of patients requiring enteral and parenteral feeding).
3. Describe the design, operation and performance of biochemical techniques used to assess digestion and absorption.
4. Describe the design, operation and performance of biochemical

techniques used in the assessment of pancreatic function and the detection of pancreatic disease.
5. Understand the need to select appropriate sample and method for the estimation of trace elements and vitamins (including direct and indirect methods).
6. Understand the role of clinical biochemistry in the assessment of trace element and vitamin status in health and disease.
7. Describe the design, operation and performance of biochemical techniques used for the analysis of samples for trace elements and vitamins.
8. Describe the partnership of biochemical nutrition to other clinical specialisms in the investigation of nutritional disorders.

Learning Outcomes: Associated Work Based Learning

High level description of the work based learning that accompanies this academic module. Further details are contained within the work based training manual.

On successful completion of this module the trainee will:

1. Understand and demonstrate the ability to perform the range of laboratory and point of care techniques used in the workplace to investigate nutritional disorders.
2. Gain experience of the clinical and laboratory investigation and management of nutritional status including the interpretation and reporting of results in the correct clinical context.
3. Gain experience of the clinical and laboratory investigation and management of digestion and absorption including the interpretation and reporting of results in the correct clinical context.
4. Gain experience of the clinical and laboratory investigation and management of pancreatic function including the interpretation and reporting of results in the correct clinical context.
5. Gain experience of the clinical and laboratory investigation and management of disorders of iron and haem.
6. Understand and demonstrate the ability to perform laboratory techniques used in the workplace to investigate trace element and vitamin status.
7. Gain experience of the clinical and laboratory investigation of trace element and vitamin status including interpretation and reporting in the correct clinical context.
8. Gain experience of the partnership of biochemical nutrition to other clinical specialisms in the investigation of nutritional disorders.

Learning Outcomes: Associated Personal Qualities and Behaviours (Professionalism)

On successful completion of this module the trainee will, in the context of clinical biochemistry:

1. Present complex ideas in simple terms in both oral and written formats.

2. Consistently operate within sphere of personal competence and level of authority.
3. Manage personal workload and objectives to achieve quality of care.
4. Actively seek accurate and validated information from all available sources.
5. Select and apply appropriate analysis or assessment techniques and tools.
6. Evaluate a wide range of data to assist with judgements and decision making.
7. Conduct a suitable range of diagnostic, investigative or monitoring procedures with due care for the safety of self and others.
8. Report problems and take part in restorative action within quality control/assurance requirements to address poor performance.
9. Interpret data and convert into knowledge for use in the clinical context of individual and groups of patients.
10. Work in partnership with colleagues, other professionals, patients and their carers to maximise patient care.

Indicative Content

- Gastrointestinal disorders: Physiology and biochemistry of digestion and absorption; maldigestion and malabsorption; pancreatitis (acute and chronic); coeliac disease; inflammatory bowel disease; anaemias; peptic ulcer disease; pyloric obstruction; carcinoid syndrome
- Gastrointestinal function testing: amylase; iron, ferritin, vitaminB12 and folate; calprotectin and lactoferrin, elastase; urea breath testing; gut hormones
- Protein energy balance and malnutrition; markers of nutritional status; assessment of nutritional status in elective, acute and chronic conditions, burns, multiple injury and sepsis; principles and practical nutritional support (enteral, parenteral);
- Trace elements in health and disease
- Methods of measurement of trace elements in biological samples; atomic absorption/emission; inductively coupled plasma mass spectrometry (ICP-MS)
- Vitamins in health and disease; syndromes of vitamin deficiency and excess
- Methods of measuring vitamins in biological samples
- Porphyrin metabolism, porphyrin measurement, systematic investigation of the porphyrias

Division: **Life Sciences**
Theme: **Blood Sciences**
Specialism: **Clinical Biochemistry**
Year 3: **CB-5: Drug Investigation [10 Credits]**

This module will provide the trainee with the knowledge and understanding of basic pharmacology and the mechanism of action of drugs. They will understand pharmacokinetics and pharmacogenomics. They will optimise the use of commonly prescribed therapeutic drugs. They will be able to investigate the poisoned patient; screen for and confirm the presence of drugs of abuse. They will perform assays to assess therapeutic and toxic drugs using a range of methods and gain experience of the interpretation of results in a range of acute and chronic clinical conditions.

Learning Outcomes: Knowledge and Understanding

On successful completion of this module the trainee will:

1. Understand the fundamental principles of pharmacokinetics.
2. Understand the fate of foreign compounds in the human body and the biochemical basis of their desired and undesired actions.
3. Be able to identify the appropriate sampling time and sample type for a range of therapeutically monitored drugs.
4. Describe the design, operation and performance of appropriate analytical methods for the detection and/or estimation of drugs or poisons.
5. Understand the major toxicity mechanisms in the human.
6. Understand the investigation of a suspected drug poisoning and related clinical conditions.
7. Understand the medico legal status of laboratory samples, including chain of custody principles.
8. Understand and utilise information on liver and renal function, plus genetic information in the clinical interpretation of drug results.
9. Understand analytical sensitivity and specificity in the context of drug investigation.
10. Describe the partnership of biochemical drug investigation to other clinical specialisms in drug investigation.

Learning Outcomes: Associated Work Based Learning

High level description of the work based learning that accompanies this academic module. Further details are contained within the work based training manual.

On successful completion of this module the trainee will:

1. Understand and demonstrate the ability to perform the range of laboratory and point of care techniques used in the workplace to monitor therapeutic drug concentrations.
2. Gain experience of the clinical and laboratory investigation and

management of patients receiving therapeutic drugs including the interpretation and reporting of results in the correct clinical context.
3. Understand and demonstrate the ability to perform the range of laboratory and point of care techniques used in the workplace to investigate drugs of abuse and poisons.
4. Gain experience of the clinical and laboratory investigation of patients taking drugs of abuse including interpretation and reporting of results in the correct clinical and legal context.
5. Gain experience of the clinical and laboratory investigation of the poisoned patient including interpretation and reporting of results in the correct clinical and legal context.
6. Gain experience of the partnership of biochemical drug investigation to other clinical specialisms in drug investigation.

Learning Outcomes: Associated Personal Qualities and Behaviours (Professionalism)

On successful completion of this module the trainee will, in the context of clinical biochemistry:

1. Present complex ideas in simple terms in both oral and written formats.
2. Consistently operate within sphere of personal competence and level of authority.
3. Manage personal workload and objectives to achieve quality of care.
4. Actively seek accurate and validated information from all available sources.
5. Select and apply appropriate analysis or assessment techniques and tools.
6. Evaluate a wide range of data to assist with judgements and decision making.
7. Conduct a suitable range of diagnostic, investigative or monitoring procedures with due care for the safety of self and others.
8. Report problems and take part in restorative action within quality control/assurance requirements to address poor performance.
9. Interpret data and convert into knowledge for use in the clinical context of individual and groups of patients.
10. Work in partnership with colleagues, other professionals, patients and their carers to maximise patient care.

Indicative Content

- Basic pharmacology, mechanism of action of drugs, drug metabolism
- Pharmacokinetics: Half life, dosage prediction
- Pharmacogenomics
- Therapeutic drug monitoring: digoxin, lithium, antiepileptics, theophylline, methotrexate, immunosuppressive drugs, antibiotics
- Metabolic effects of ethanol; alcohol excess
- Overdose: salicylate, paracetamol, barbiturate, tricyclic antidepressants
- Drug addiction: alcohol, opiates, amphetamines, benzodiazepines, cocaine, cannabis
- Poisoning: carbon monoxide, lead , mercury, aluminium, iron, paraquat, ethylene glycol, methanol and other organic alcohols, organophosphates

- Laboratory investigation of the unconscious or deceased poisoned patient
- Laboratory methods for the measurement of therapeutic and toxic drugs from screening to confirmation

Division:	**Life Sciences**
Theme;	**Blood Sciences**
Specialism:	**Clinical Biochemistry**
Year 3:	**CB-6: Pregnancy, Neonatal & Paediatric Clinical Biochemistry [10 Credits]**

This module will provide the trainee with the knowledge and understanding of the physiology of normal pregnancy and the impact on biochemical parameters. They will understand maternal and neonatal screening programmes and the investigation of neonates and children who may have inborn errors of metabolism. They will be performing assays to assess maternal, neonatal and paediatric status using a range of methods and gain experience of the interpretation of results in a range of conditions.

Learning Outcomes: Knowledge and Understanding

On successful completion of this module the trainee will:

1. Understand and recognise the non-pathological changes in biochemical parameters during pregnancy and the need for specific reference ranges.
2. Understand the clinical use of biochemical parameters in pregnancy and the interpretation of results in a range of conditions affecting mother and/or foetus.
3. Describe the design, operation and performance of biochemical and molecular techniques used in pregnancy and paediatric biochemistry.
4. Understand and explain the requirements for antenatal and newborn screening programmes.
5. Describe the design, operation and performance of analytical techniques used in antenatal and newborn screening programmes.
6. Understand the clinical and laboratory investigation of a neonate who is failing to thrive.
7. Understand the clinical and laboratory investigation of an infant presenting with hypoglycaemia.
8. Understand the clinical and laboratory investigation of an infant presenting with hyperammonaemia.
9. Understand the clinical and laboratory investigation of an infant presenting with jaundice.
10. Understand the need to convey complex biochemical information to inform the multidisciplinary team about cause and consequences of inborn errors of metabolism.

Learning Outcomes: Associated Work Based Learning

High level description of the work based learning that accompanies this academic module. Further details are contained within the work based training manual.

On successful completion of this module the trainee will:

1. Understand and demonstrate the ability to perform the range of biochemical, point of care and molecular techniques used in the workplace to investigate pregnant women, neonates and infants.
2. Demonstrate the ability to use reference ranges for the interpretation and reporting of results from pregnant women, neonates and infants in the correct clinical context.
3. Gain experience of a range of conditions associated with pregnancy.
4. Gain experience of a range of antenatal and newborn screening programmes including the interpretation and reporting of results.
5. Gain experience of the clinical and laboratory investigation and management of neonates and infants who fail to thrive including the interpretation and reporting of results in the correct clinical context.
6. Gain experience of the clinical and laboratory investigation of infants with hypoglycaemia including interpretation and reporting of results in the correct clinical context.
7. Gain experience of the clinical and laboratory investigation of infants with jaundice including interpretation and reporting of results in the correct clinical context.
8. Gain experience of the clinical and laboratory investigation of neonates and infants suspected of having an inborn error of metabolism.
9. Gain experience of the partnership between paediatric clinical biochemistry and other clinical specialisms in the investigation of neonates and infants.

Learning Outcomes: Associated Personal Qualities and Behaviours (Professionalism)

On successful completion of this module the trainee will, in the context of clinical biochemistry:

1. Present complex ideas in simple terms in both oral and written formats.
2. Consistently operate within sphere of personal competence and level of authority.
3. Manage personal workload and objectives to achieve quality of care.
4. Actively seek accurate and validated information from all available sources.
5. Select and apply appropriate analysis or assessment techniques and tools.
6. Evaluate a wide range of data to assist with judgements and decision making.
7. Conduct a suitable range of diagnostic, investigative or monitoring procedures with due care for the safety of self and others.
8. Report problems and take part in restorative action within quality control/assurance requirements to address poor performance.
9. Interpret data and convert into knowledge for use in the clinical context of individual and groups of patients.
10. Work in partnership with colleagues, other professionals, patients and their carers to maximise patient care.

Indicative Content

- Pregnancy: normal maternal and foetal physiology; complications, detection of abnormalities
- Implications of pregnancy on reference ranges
- Monitoring of at risk pregnant patients with diabetes, thyroid disease, liver disease
- Testing in pregnancy for hydatidiform mole, ectopic pregnancy, choriocarcinoma;
- Biochemical antenatal screening for Down Syndrome, neural tube defects and other foetal malformations
- Neonates: Biochemical problems of the newborn including fluid balance, hypoglycaemia, jaundice, liver disease, calcium homeostasis, hypomagnesaemia, hyperammonaemia; intersex disorders
- Implications of testing neonates: sample size, effect of matrix on methods, reference ranges
- Biochemical newborn screening: e.g. phenylketonuria; medium chain acyl CoA dehydrogenase and other inborn errors of metabolism; hypothyroidism; cystic fibrosis, sickle cell disease
- Childhood: Hypoglycaemia; lactic acidosis; hyperammonaemia; calcium and phosphate disorders; Reyes Syndrome; precocious puberty; delayed puberty
- Inborn errors of metabolism: Principles of investigation; quantitative and qualitative enzyme abnormalities; disorders of amino acids, organic acids, mucopolysaccharides, peroxisomes, urea cycle, purines and pyrimidines, mitochondrial and lysosomal disorders
- Methodology for biochemical investigation of neonates and children, including chromatography tandem mass spectrometry and molecular diagnostics

5.0 Specialist Modules in Haematology and Transfusion Science

	Module Titles			
Year 3	HT-4: Haemostasis [10]	HT-5: Haematological Malignancy [10]	HT-6: Transfusion 2 [10]	HT-Res: Research Project in Haematology and Transfusion Science [30]
Year 2	Research Methods [10]	HT-2: Clinical Haematology [10]	HT-3: Transfusion 1 [10]	HT-Res: Research Project in Haematology and Transfusion Science [30]
Year 1	Healthcare Science - integrating science and professional practice [20]		Introduction to Blood Sciences - underpinning knowledge for rotational elements and integrated professional practice [40]	

Generic Modules: Common to all divisions of Healthcare Science

Division/Theme Specific Modules: Common to a division or theme

Specialist Modules: Specific to a specialism

5.1 Year 2 Specialist Practice

Division:	**Life Sciences**
Theme:	**Blood Sciences**
Specialism:	**Haematology and Transfusion Science**
Year 2:	**HT-2: Clinical Haematology [10 Credits]**

These modules provide the trainee with the knowledge that underpins specialist training in Haematology and Transfusion Science and provide the trainee with the tools to undertake learning in the workplace.

This module will provide the trainee with the knowledge and understanding of the pathophysiology and clinical presentation of a range of disorders associated with abnormalities of red cell, white cell and haemostatic parameters. They will perform methods related to red cell, white cell and haemostatic function and gain experience of the interpretation of patient results in a variety of clinical settings.

Learning Outcomes: Knowledge and Understanding

On successful completion of this module the trainee will:

1. Understand common dietary and acquired anaemias and hereditary red cell disorders.
2. Understand the molecular basis, presentation, diagnosis and management of haemoglobinopathies and thalassaemia.
3. Understand the principles and practice of the national screening programme for sickle cell disease and thalassaemia.
4. Understand the diversity, investigation, diagnosis and clinical relevance of hereditary red cell disorders.
5. Understand the basis, investigation, diagnosis and clinical relevance of white cell disorders.
6. Understand primary and secondary haemostasis.
7. Understand control mechanisms in haemostasis.
8. Understand the factors that affect the sensitivity and specificity of tests of haemostasis.
9. Describe the partnership of clinical haematology to other clinical specialisms in the investigation of haematological disorders.

Learning Outcomes: Associated Work Based Learning

High level description of the work based learning that accompanies this academic module. Further details are contained within the work based training manual.

On successful completion of this module the trainee will:

1. Understand and demonstrate the ability to perform the range of laboratory and molecular techniques used in the workplace to investigate anaemia, red cell disorders and white cell disorders.

2. Gain experience of the clinical and laboratory investigation and management of dietary and acquired anaemias and hereditary red cell disorders including the interpretation and reporting of results in the correct clinical context.
3. Gain experience of the national screening programme for sickle cell disease and thalassaemia.
4. Gain experience of the clinical and laboratory investigation and management of white cell disorders including the interpretation and reporting of results in the correct clinical context.
5. Understand and demonstrate the ability to perform the range of laboratory and point of care techniques used in the workplace to investigate disorders of haemostasis.
6. Gain experience of the clinical and laboratory investigation and management of disorders of haemostasis including the interpretation and reporting of results in the correct clinical context.
7. Gain experience of the partnership of clinical haematology to other clinical specialisms in the investigation of haematological disorders.

Learning Outcomes: Associated Personal Qualities and Behaviours (Professionalism)

On successful completion of this module the trainee will, in the context of haematology and transfusion science:

1. Present complex ideas in simple terms in both oral and written formats.
2. Consistently operate within sphere of personal competence and level of authority.
3. Manage personal workload and objectives to achieve quality of care.
4. Actively seek accurate and validated information from all available sources.
5. Select and apply appropriate analysis or assessment techniques and tools.
6. Evaluate a wide range of data to assist with judgements and decision making.
7. Conduct a suitable range of diagnostic, investigative or monitoring procedures with due care for the safety of self and others.
8. Report problems and take part in restorative action within quality control/assurance requirements to address poor performance.
9. Interpret data and convert into knowledge for use in the clinical context of individual and groups of patients.
10. Work in partnership with colleagues, other professionals, patients and their carers to maximise patient care.

Indicative Content

Have the knowledge and understanding of physiology and pathophysiology, its investigation and diagnosis as it applies to the specialism in the following:

- **Red Cells**
  - Normal physiology and bone marrow production of red cells
  - Structure and synthesis of normal and abnormal haemoglobin

    - Classification of anaemias
    - Iron metabolism and effect of iron deficiency and overload on erythropoesis
    - Vitamin B12 and folate metabolism and effect of deficiency on erythropoesis
    - Hereditary and acquired haemolytic anaemia
    - Principles, scientific basis, range and selection of analytical procedures applied in the investigation of anaemia
    - Presentation and laboratory investigation of anaemia, including iron deficiency, megaloblastic, haemolytic and enzymeopathies
    - Clinical interpretation of diagnostic results, treatment strategies and management
- Molecular basis of abnormal haemoglobins and thalassaemia syndromes
- The National Screening Programme for sickle cell disease and thalassaemia
- Phenotypic and genotypic laboratory methods
- Diagnosis of red cell enzymopathies
- IQC and EQA in red cell disorders
- Abnormalities in adults and children
    - Clinical complications of red cell enzymopathies and haemoglobinopathies British Committee for Standards in Haematology (BCSH) Guidelines relevant to red cell investigation

- **White Cells**
    - Normal leucopoeisis
    - Normal structure and function of white cells
    - Granulocytes, monocytes and their benign disorders
    - Disorders of neutrophil and monocyte function
    - Causes of leukocytosis, monocytosis and neutropenia
    - Principles, scientific basis, range and selection of analytical procedures applied in the investigation of white cell disorders
    - Presentation and laboratory investigation of white cell disorders
    - Clinical interpretation of diagnostic results, treatment strategies and management
    - BCSH Guidelines relevant to these white cell disorders

- **Haemostasis**
    - Primary haemostasis, role in supporting normal haemostasis; including blood vessel structure and function; platelet structure and function
    - Role of von Willebrand factor (VWF) in the interaction between blood vessels and platelets
    - Secondary haemostasis, including coagulation factors structure and function, feedback and control mechanisms, localisation of clot
    - Vitamin K metabolism in the synthesis of functioning coagulation factors
    - Cell-based models of haemostasis and the role of tissue factor
    - Natural inhibitors of coagulation
    - Fibrinolysis, including activation, inhibition and the breakdown mechanism. Fibrin clearance and degradation products
    - Use and monitoring of anticoagulant therapy

- BCSH Guidelines relevant to haemostasis

Division: Life Sciences
Theme: Blood Sciences
Specialism: Haematology and Transfusion Science
Year 2: HT-3: Transfusion 1 [10 Credits]

This module will provide the trainee with an in depth knowledge of blood groups and their clinical significance in transfusion medicine. It will also provide the knowledge and skills required to work at a basic level within the transfusion hospital laboratory, operating within regulatory requirements, and providing safe and compatible blood and components for patients.

Learning Outcomes: Knowledge and Understanding

On successful completion of this module the trainee will:

1. Understand the genetic basis the major blood groups, and the significance of red cell antigens and antibodies in transfusion medicine.
2. Describe the design, operation and performance of pre-transfusion procedures and serological tests and their use to ensure provision of compatible blood for patients.
3. Understand the procedures and practices required to select and issue appropriate, blood, components and products for patients.
4. Understand the principles of blood stock management, the need for full traceability and maintenance of the cold chain.
5. Understand the need to work within national guidelines for transfusion, (e.g. BCSH), applicable regulatory requirements (e.g. UK Blood Safety and Quality Regulations (BSQR)), and quality management systems in the hospital transfusion laboratory.
6. Describe the partnership between the hospital blood transfusion laboratory and other clinical specialisms in the transfusion process.

Learning Outcomes: Associated Work Based Learning

High level description of the work based learning that accompanies this academic module. Further details are contained within the work based training manual.

On successful completion of this module the trainee will:

1. Understand and demonstrate the ability to perform routine pre-transfusion procedures and serological tests, interpret results and resolve anomalies to ensure provision of compatible blood for patients.
2. Demonstrate the ability to select and issue appropriate blood, components and products for patients with a wide range of clinical conditions, in routine and emergency settings.
3. Demonstrate the ability to investigate suspected adverse reactions according to clinical presentation

4. Gain experience of blood stock management including full traceability and maintenance of the cold chain.
5. Gain experience of working within national guidelines for transfusion (e.g. BCSH), applicable regulatory requirements (e.g. BSQR), and quality management systems in the hospital transfusion laboratory.
6. Gain experience of the partnership between the hospital blood transfusion laboratory and other clinical specialisms in the transfusion process.

Learning Outcomes: Associated Personal Qualities and Behaviours (Professionalism)

On successful completion of this module the trainee will, in the context of haematology and transfusion science:

1. Present complex ideas in simple terms in both oral and written formats.
2. Consistently operate within sphere of personal competence and level of authority.
3. Manage personal workload and objectives to achieve quality of care.
4. Actively seek accurate and validated information from all available sources.
5. Select and apply appropriate analysis or assessment techniques and tools.
6. Evaluate a wide range of data to assist with judgements and decision making.
7. Conduct a suitable range of diagnostic, investigative or monitoring procedures with due care for the safety of self and others.
8. Report problems and take part in restorative action within quality control/assurance requirements to address poor performance.
9. Interpret data and convert into knowledge for use in the clinical context of individual and groups of patients.
10. Work in partnership with colleagues, other professionals, patients and their carers to maximise patient care.

Indicative Content

- Blood group systems, genes antigens, antibodies and their clinical significance in transfusion medicine
- Immunological basis of antibody mediated red cell destruction
- Factors affecting antigen: antibody reactions in vitro and principles of serological tests
- Intra-operative autologous transfusion technologies
- Pre-transfusion testing protocols to establish compatibility
- IT systems, automation and security
- Indications for and administration of blood components
- Selection of components for patients with special requirements e.g. sickle cell disease (SCD), neonates
- Transfusion support for transplant patients (bone marrow transplant (BMT), stem cell, solid organ)
- Appropriate use of blood and components
- Novel blood derivatives and therapeutics and their application

- Alternatives to transfusion
- Management of major haemorrhage
- Management of major incidents
- Management of transfusion reactions
- Hospital blood stocks management and traceability
- Haemovigilance and incident / error management
- Cold chain, transport of components and blood tracking systems
- Quality management systems in transfusion
- Transfusion guidelines

5.2 Year 2 and 3 Research Project

Division:	**Life Sciences**
Theme:	**Blood Sciences**
Specialism:	**Haematology and Transfusion Science**
Year 2 and 3:	**HT-Res: Research Project in Haematology and Transfusion Science [60 Credits]**

The overall aim of this module, building on the Research Methods module is for the trainee to undertake research that shows originality in the application of knowledge, together with a practical understanding of how established techniques of research and enquiry are used to create and interpret new information in a specialism of healthcare science. During Years 2 and 3 the trainee will undertake an original piece of research involving the application of scientific investigation to one or more clinical situations.

The trainee will also be expected to complete three shorter health services research projects to gain an understanding of the health services contexts within which clinical research is undertaken.
One each in:

- Evidence-based practice
- Clinical audit
- Supporting professional service users

Learning Outcomes: Knowledge and Understanding

On successful completion of this module the trainee will:

1. Evaluate the basic scientific principles underpinning research.
2. Critically evaluate the principles and practice of evidence based medicine.
3. Explain and critically evaluate individual research publications according to evidence based medicine criteria.
4. Critically evaluate, analyse and summarise current research and advanced scholarship in the specialism and draw justified conclusions from the evidence.
5. Explain the current system of grading research publications.
6. Explain the use and limitations of reference manager systems.
7. Describe and appraise the process leading to publication of a research

paper.
8. Describe the audit cycle and the importance of clinical audit in improving patient care, multidisciplinary working and in optimising laboratory medicine service provision.
9. Recognise the importance of innovation in healthcare science.

Learning Outcomes: Associated Work Based Practical Skills

On successful completion of this module the trainee will:

1. Establish the core skills necessary for scientific research in a clinical environment.
2. Develop and propose a hypothesis.
3. Undertake a research project to test the hypothesis from conception to completion.
4. Confirm the necessary ethical, audit and/or Research and Development (R&D) approval.
5. Assemble a body of data and analyse the data using appropriate statistical techniques.
6. Prepare a written project report that analyses the findings and identifies strengths and weaknesses of the research project.
7. Communicate knowledge or arguments from the research project both orally and in writing including presentation at a work based meeting.
8. Critically evaluate and draw conclusions about the quality of relevant research publications.
9. Contribute to and take an active part in the performance of a clinical audit that involves completion of the audit cycle.
10. Demonstrate the importance of multidisciplinary working in the design, delivery and optimisation of improved laboratory medicine services.

Learning Outcomes: Associated Personal Qualities and Behaviours (Professionalism)

On successful completion of this module the trainee will:

1. Further develop critical analytical skills.
2. Evaluate and apply evidence.
3. Work within an ethical framework.
4. Work independently or as a member of a team.
5. Demonstrate effective time management and organisation.
6. Exercise initiative and personal responsibility.
7. Reflect on performance and seek help and advice when necessary.

Indicative Content

- Literature searching
- Principles and good practice examples of evidence based medicine
- The audit cycle and its good practice examples of its application to clinical audit as a means of service development
- Critical analysis

- Research project that may include:
    - Systematic review
    - Evaluation of new methodologies
    - Investigation to improve performance of a method
    - Evaluation of new/modified quality assurance of a method
    - Audit of method performance across a range of departments
    - Critical analysis of evidence-base underpinning a specified procedure
- Communications skills
- Report writing
- Presentation skills

5.3 Year 3 Specialist Practice

Division:	**Life Sciences**
Theme:	**Blood Sciences**
Specialism:	**Haematology and Transfusion Science**
Year 3:	**HT-4: Haemostasis [10 Credits]**

This module will provide the trainee with the detailed knowledge and understanding of the pathophysiology and clinical presentation of a range of acquired and genetic bleeding disorders and thrombotic disorders. They will perform relevant laboratory methods and gain experience of the interpretation of patient results in a variety of clinical settings.

Learning Outcomes: Knowledge and Understanding

On successful completion of this module the trainee will:

1. Understand congenital and acquired bleeding disorders.
2. Describe the design, operation and performance of laboratory, molecular and point of care techniques used in the investigation of bleeding disorders.
3. Understand the diagnosis and management of bleeding disorders.
4. Understand the causes and risks, diagnosis and treatment options of thrombophilia.
5. Describe the partnership between the haematology laboratory and other clinical specialisms in the investigation of bleeding disorders.

Learning Outcomes: Associated Work Based Learning

High level description of the work based learning that accompanies this academic module. Further details are contained within the workplace training manual.

On successful completion of this module the trainee will:

1. Understand and demonstrate the ability to perform the range of laboratory, molecular and point of care testing techniques used in the workplace to diagnose and monitor treatment of bleeding disorders and

thrombophilia.
2. Gain experience of the clinical and laboratory investigation and management of congenital and acquired bleeding disorders including the interpretation and reporting of results in the correct clinical context.
3. Gain experience of the clinical and laboratory investigation and management of thrombophilia including the interpretation and reporting of results in the correct clinical context.
4. Gain experience of the partnership between the haematology laboratory and other clinical specialisms in the investigation of bleeding disorders and thrombophilia.

Learning Outcomes: Associated Personal Qualities and Behaviours (Professionalism)

On successful completion of this module the trainee will, in the context of haematology and transfusion science:

1. Present complex ideas in simple terms in both oral and written formats.
2. Consistently operate within sphere of personal competence and level of authority.
3. Manage personal workload and objectives to achieve quality of care.
4. Actively seek accurate and validated information from all available sources.
5. Select and apply appropriate analysis or assessment techniques and tools.
6. Evaluate a wide range of data to assist with judgements and decision making.
7. Conduct a suitable range of diagnostic, investigative or monitoring procedures with due care for the safety of self and others.
8. Report problems and take part in restorative action within quality control/assurance requirements to address poor performance.
9. Interpret data and convert into knowledge for use in the clinical context of individual and groups of patients.
10. Work in partnership with colleagues, other professionals, patients and their carers to maximise patient care.

Indicative Content

- Hereditary and acquired primary and secondary bleeding disorders; including nature and sites of bleeding; risks associated with severity
- Hereditary and acquired thrombotic disorders; including structure and aetiology of thrombus formation; relative risk and environmental factors
- The genetic basis and functional defects of hereditary bleeding and thrombotic disorders
- Disseminated intravascular coagulation (DIC)
- Principles, scientific basis, range and selection of analytical procedures applied in the investigation of bleeding and thrombotic disorders
- Presentation and laboratory investigation of bleeding and thrombotic disorders. BCSH guidelines relevant to this area
- Clinical interpretation of diagnostic results, treatment strategies and management (including clotting factor replacement therapy; anticoagulant therapy, prophylaxis); family studies

Division: Life Sciences
Theme: Blood Sciences
Specialism: Haematology and Transfusion Science
Year 3: HT-5: Haematological Malignancy [10 Credits]

This module will provide the trainee with knowledge and understanding of the pathophysiology, clinical presentation and management of patients with haematological malignancy. They will perform relevant laboratory methods and gain experience of the interpretation of patient results in a variety of clinical settings.

Learning Outcomes: Knowledge and Understanding

On successful completion of this module the trainee will:

1. Understand the classification, aetiology and genetics of haematological malignancy.
2. Describe the design, operation and performance of laboratory and molecular techniques used in the investigation and management of haematological malignancy.
3. Understand the principles of bone marrow and stem cell harvests and their role in transplantation programmes.
4. Understand the principles and mechanisms of chemotherapy, immunotherapy and radiotherapy and their use in haematological malignancy.
5. Understand the importance and implementation of national (e.g. NICE) guidance on the diagnosis and management of haematological cancer.
6. Understand the importance of integrated diagnosis of haematological malignancy.
7. Describe the partnership between the haematology laboratory and other clinical specialisms in the investigation of haematological malignancy.

Learning Outcomes: Associated Work Based Learning

High level description of the work based learning that accompanies this academic module. Further details are contained within the work based training manual.

On successful completion of this module the trainee will:

1. Understand and demonstrate the ability to perform the range of laboratory and molecular testing techniques used in the workplace to diagnose and monitor treatment of haematological malignancy.
2. Gain experience of the clinical and laboratory investigation and management of haematological malignancy including the interpretation and reporting of results in the correct clinical context.
3. Gain experience of the application of national and international guidance (e.g. NICE) on the diagnosis and management of haematological cancer.
4. Gain experience of the partnership between the haematology laboratory

and other clinical specialisms in the investigation of haematological malignancy.

Learning Outcomes: Associated Personal Qualities and Behaviours (Professionalism)

On successful completion of this module the trainee will, in the context of haematology and transfusion science:

1. Present complex ideas in simple terms in both oral and written formats.
2. Consistently operate within sphere of personal competence and level of authority.
3. Manage personal workload and objectives to achieve quality of care.
4. Actively seek accurate and validated information from all available sources.
5. Select and apply appropriate analysis or assessment techniques and tools.
6. Evaluate a wide range of data to assist with judgements and decision making.
7. Conduct a suitable range of diagnostic, investigative or monitoring procedures with due care for the safety of self and others.
8. Report problems and take part in restorative action within quality control/assurance requirements to address poor performance.
9. Interpret data and convert into knowledge for use in the clinical context of individual and groups of patients.
10. Work in partnership with colleagues, other professionals, patients and their carers to maximise patient care.

Indicative Content

Current concepts on the aetiology, pathogenesis and molecular mechanisms involved in

- Myeloid malignancy
- Lymphoid leukaemia
- Lymphoma
- Myeloma and plasma cell disorders
- Myelodysplastic syndromes
- Diagnosis and management of the above
- Myeloproliferative disorders and their diagnosis and management
- Bone marrow failure syndromes
- Blood and bone marrow transplantation regimes
- Principles of chemo- and radio-therapy and the rationale behind Medical Research Council (MRC) acute myeloid leukaemia (AML) and acute lymphoblastic leukaemia (ALL) trials
- Survival rates in haematological malignancy
- IQC and EQA in haemato-oncology
- BCSH guidelines in haemato-oncology; NICE improved outcome guidance

Division: **Life Sciences**
Theme: **Blood Sciences**
Specialism: **Haematology and Transfusion Science**
Year 3: **HT-6: Transfusion 2 [10 credits]**

This module will provide the trainee with knowledge and practical skills to resolve serological anomalies in pre-transfusion testing and to know when further referral is necessary. It will also enable them to undertake antenatal testing and procedures to prevent anti-D sensitisation of women with child bearing potential. They will perform relevant laboratory methods and gain experience of the interpretation of patient results in a variety of clinical settings. The module will also provide the trainee with an understanding of the principles and practice of blood transfusion in a blood services setting, and the relevance of these procedures in reducing transfusion risk and providing optimum component therapy for patients.

Learning Outcomes: Knowledge and Understanding

On successful completion of this module the trainee will:

1. Understand the clinical and technical basis of blood grouping anomalies and how to resolve these to make safe blood group interpretations for patients and donors.
2. Understand the process involved in resolving complex red cell antibody cases using non-routine serological and molecular testing.
3. Understand the aetiology and classification of auto immune haemolytic anaemias, and the testing required to provide effective transfusion support.
4. Understand algorithms for routine and non-routine antenatal testing, and the use of anti-D prophylaxis and foetal maternal hemorrhage (FMH) testing to prevent sensitization to the D antigen.
5. Understand the role of the transfusion specialist in diagnosis, management and treatment of haemoloytic disease of the foetus and newborn (HDFN).
6. Understand the rationale behind the selection of immunohaematological tests for new and established donors and how the requirements for donor testing differ from those for patient testing.
7. Understand methods for preparation of blood components and products, and the requirement to work in conformance with quality systems and legislation such as Good Manufacturing Practice (GMP).
8. Describe the design, operation and performance of assays for markers of transfusion transmitted infections (TTI). Understand which additional tests are required for specific groups of donors, and the algorithms for confirming positive results and for deferral / reinstatement of donors, and the impact on blood safety.
9. Understand donor issues, including donor selection, recruitment, motivation and care.
10. Understand the principles of bone marrow and stem cell transplant, Histocompatibility and Immunogenetics (H&I) testing and cord banking.

Learning Outcomes: Associated Work Based Learning

High level description of the work based learning that accompanies this academic module. Further details are contained within the work based training manual.

On successful completion of this module the trainee will:

1. Demonstrate the ability to troubleshoot serological tests, investigate patient and donor blood grouping anomalies, and to make interpretations in clinical context.
2. Gain experience of selecting, performing and interpreting the results of non-routine additional tests to elucidate antibodies in complex cases (mixtures, high frequency etc), and liaising with clinicians and blood services regarding transfusion support.
3. Understand the selection of and demonstrate the ability to perform serological tests for differential diagnosis of autoimmune haemolytic anaemia (AIHA) and for provision of suitable blood for transfusion.
4. Understand and gain experience of the use of algorithms for routine and non-routine antenatal testing and the use of anti-D prophylaxis and FMH testing.
5. Understand the selection of and demonstrate the ability to perform tests to predict and monitor HDFN, and provide appropriate transfusion therapy for the fetus and neonate.
6. Demonstrate an understanding of the methods used to prepare blood components and products within a defined quality and legislative framework.
7. Demonstrate an understanding of assays for TTI markers and the use of algorithms to confirm positive results, and be able to interpret results and draw conclusions about donor suitability.
8. Gain experience of the linkages between the hospital blood transfusion department and the specialist blood transfusion services.

Learning Outcomes: Associated Personal Qualities and Behaviours (Professionalism)

On successful completion of this module the trainee will, in the context of haematology and transfusion science:

1. Present complex ideas in simple terms in both oral and written formats.
2. Consistently operate within sphere of personal competence and level of authority.
3. Manage personal workload and objectives to achieve quality of care.
4. Actively seek accurate and validated information from all available sources.
5. Select and apply appropriate analysis or assessment techniques and tools.
6. Evaluate a wide range of data to assist with judgements and decision making.
7. Conduct a suitable range of diagnostic, investigative or monitoring procedures with due care for the safety of self and others.

8. Report problems and take part in restorative action within quality control/assurance requirements to address poor performance.
9. Interpret data and convert into knowledge for use in the clinical context of individual and groups of patients.
10. Work in partnership with colleagues, other professionals, patients and their carers to maximise patient care.

Indicative Content

- Strategies for resolution of complex antibody identification cases
- Causes and investigation of ABO and D typing anomalies
- Aetiology, classification, investigation and management of AIHA
- Aetiology and management of haemolytic disease of the fetus and newborn (HDFN),
- Routine antenatal testing, and follow-up of cases with red cell antibodies
- FMH testing
- Molecular techniques for genotyping and antibody identification
- UK guidelines for blood transfusion services, GMP [Orange] Guide, EU directives, BSQR, Consumer Protection Act and Product Liability
- Principles of donor selection, recruitment, motivation, and care
- Blood collection, methods to prevent infection, and storage prior to processing
- Apheresis and use / management of specialist panels
- Mandatory and discretionary testing for transfusion transmitted infections, and criteria for donor exclusion / reinstatement
- Principles of TTI assay methods, selection and validation
- Variant Creutzfeldt-Jacob disease (vCJD), emerging pathogens, and pathogen reduction strategies
- Blood component production and quality control, and changes to blood and components on storage
- The national frozen blood bank and provision of rare red cells
- Fractionated products - types, storage & use
- Principles of bone marrow and stem cell transplantation
- Principles of testing for human leucocyte antigens (HLA), human platelet antigens (HPA) and neutrophil antigens / antibodies
- Principles of cord banking

6.0 Specialist Modules for Clinical Immunology

	Module Titles			
Year 3	CI-4: Hypersensitivity and Allergy [10]	CI-5: Haematological Malignancies and Transplantation [10]	CI-6: Autoimmunity [10]	CI-Res: Research Project in Immunology [30]
Year 2	Research Methods [10]	CI-2: Immunity: Implications for Infection and Cancer [10]	CI-3: Immunodeficiency and Immunotherapy [10]	CI-Res: Research Project in Immunology [30]
Year 1	Healthcare Science - integrating science and professional practice [20]		Introduction to Blood Sciences – underpinning knowledge for rotational elements and integrated professional practice [40]	

Generic Modules: Common to all divisions of Healthcare Science

Division/Theme Specific Modules: Common to a division or theme

Specialist Modules: Specific to a specialism

6.0 Year 2 Specialist Practice

Division: **Life Sciences**
Theme: **Blood Sciences**
Specialism: **Clinical Immunology**
Year 2: **CI-2: Immunity: Implications for Infection and Cancer [10 Credits]**

These modules provide the trainee with the knowledge that underpins specialist training in Clinical Immunology and provide the trainee with the tools to undertake learning in the workplace.

This module will provide the trainee with knowledge, understanding and clinical significance of immunity as applied to infection and cancer. The trainee will become familiar with methods and strategies to investigate immunity and gain experience of the interpretation of patient results in a variety of clinical settings.

Learning Outcomes: Knowledge and Understanding

On successful completion of this module the trainee will:

1. Understand the role of the immune system in defence against infection.
2. Understand the role of the immune system in cancer and malignancy.
3. Describe the design, operation and performance of the tests and assays used to investigate the immune system in defence against infection.
4. Describe the design, operation and performance of the tests and assays used to investigate the immune system in cancer, particularly in haematological malignancies.
5. Describe the partnership between clinical immunology and other clinical specialism in the investigation of the immune system in infection and haematological malignancy.

Learning Outcomes: Associated Work Based Learning

High level description of the work based learning that accompanies this academic module. Further details are contained within the work based training manual.

On successful completion of this module the trainee will:

1. Understand and demonstrate the ability to select and perform immunology tests to investigate the role of the immune system in defence against infection.
2. Gain experience of the clinical and laboratory investigation of the immune system in defence against infection including the interpretation and reporting of results in the correct clinical context.
3. Understand and demonstrate the ability to select and perform immunology tests to investigate the role of the immune system in cancer and malignancy, particularly haematological malignancies.

4. Gain experience of the clinical and laboratory investigation of the immune system in cancer and malignancy including the interpretation and reporting of results in the correct clinical context.
5. Gain experience of the partnership between clinical immunology and other clinical specialisms in the investigation of the immune system in infection and malignancy.

Learning Outcomes: Associated Personal Qualities and Behaviours (Professionalism)

On successful completion of this module the trainee will, in the context of clinical immunology:

1. Present complex ideas in simple terms in both oral and written formats.
2. Consistently operate within sphere of personal competence and level of authority.
3. Manage personal workload and objectives to achieve quality of care.
4. Actively seek accurate and validated information from all available sources.
5. Select and apply appropriate analysis or assessment techniques and tools.
6. Evaluate a wide range of data to assist with judgements and decision making.
7. Conduct a suitable range of diagnostic, investigative or monitoring procedures with due care for the safety of self and others.
8. Report problems and take part in restorative action within quality control/assurance requirements to address poor performance.
9. Interpret data and convert into knowledge for use in the clinical context of individual and groups of patients.
10. Work in partnership with colleagues, other professionals, patients and their carers to maximise patient care.

Indicative Content

- Microbial Immunity
    - Inflammation (mediators; acute inflammatory response; ongoing inflammatory processes; regulation of inflammation; chronic inflammatory responses)
    - Viral Infections (immune defences; viral counter defences; human immunodeficiency virus and autoimmune deficiency syndromes (AIDS))
    - Bacterial Infections (immune defences; bacterial counter defences)
    - Parasite Infections (immune defences; parasite counter defences)
    - Fungal Infections (immune defences; fungal counter defences)
    - Immunisation and vaccination
    - Secondary immunodeficiency of infection
- Cancer Immunity
    - Tumour antigens (virally controlled antigens; silent antigens; mutant antigens; differentiation antigens; major histocompatibility complex (MHC) antigens)
    - Innate immune responses (macrophages; natural killer (NK) cells)
    - Acquired immune responses (cytotoxic T cells)

- Tumour counter defence mechanisms
- Cancer Immunotherapy (cytokines; monoclonal antibodies; antibody dependent cell-mediated cytotoxicity (ADCC); immunisation; tumour vaccines)
- Immunological diagnosis of cancers (immunofluorescence; immunogenetics; tumour markers)
- Secondary immunodeficiency

Division: Life Sciences
Theme: Blood Sciences
Specialism: Clinical Immunology
Year 2: CI-3: Immunodeficiency and Immunotherapy [10 Credits]

This module will provide the trainee with knowledge and understanding of the causes of immunodeficiency. They will understand the clinical presentation and investigation of a range of immunodeficient conditions and the principles and practice of immunotherapy. They will become familiar with methods and strategies to investigate immunodeficiency and gain experience of the interpretation of patient results in a variety of clinical settings.

Learning Outcomes: Knowledge and Understanding

On successful completion of this module the trainee will:

1. Understand the clinical implications of immunodeficiency.
2. Understand the role of the humoral and cellular components of the immune system in immunodeficiency.
3. Understand the primary and secondary causes of immunodeficiency.
4. Describe the design, operation and performance of laboratory tests and assays used to investigate and define immunodeficiency.
5. Understand the principles of immunotherapy.
6. Understand and monitor the impact of immunotherapeutic treatments.
7. Understand appropriate immunotherapeutic strategies/treatment regimes for patients with a range of primary and secondary immunodeficiencies.
8. Describe the partnership between the clinical immunology laboratory and other clinical specialisms in the investigation of immunodeficiency and immunotherapy.

Learning Outcomes: Associated Work Based Learning

High level description of the work based learning that accompanies this academic module. Further details are contained within the work based training manual.

On successful completion of this module the trainee will:

1. Understand and demonstrate the ability to select and perform immunology tests for the diagnosis and management of immunodeficiency and for the monitoring of immunotherapy.
2. Gain experience of the clinical and laboratory investigation of

immunodeficiency including the interpretation and reporting of results in the correct clinical context.
3. Gain experience of immunotherapeutic strategies and regimes for patients with a range of primary and secondary immunodeficiencies.
4. Gain experience of the partnership between the clinical immunology laboratory and other clinical specialisms in the investigation of immunodeficiency and immunotherapy.

Learning Outcomes: Associated Personal Qualities and Behaviours (Professionalism)

On successful completion of this module the trainee will, in the context of clinical immunology:

1. Present complex ideas in simple terms in both oral and written formats.
2. Consistently operate within sphere of personal competence and level of authority.
3. Manage personal workload and objectives to achieve quality of care.
4. Actively seek accurate and validated information from all available sources.
5. Select and apply appropriate analysis or assessment techniques and tools.
6. Evaluate a wide range of data to assist with judgements and decision making.
7. Conduct a suitable range of diagnostic, investigative or monitoring procedures with due care for the safety of self and others.
8. Report problems and take part in restorative action within quality control/assurance requirements to address poor performance.
9. Interpret data and convert into knowledge for use in the clinical context of individual and groups of patients.
10. Work in partnership with colleagues, other professionals, patients and their carers to maximise patient care.

Indicative Content

- Assessing immune function (T lymphocytes ; B lymphocytes ; phagocytes ; complement)
- Deficiencies of innate immunity (phagocytic cell defects; leukocyte adhesion defects; complement system defects)
- B Lymphocyte deficiencies (X-linked agammaglobulinaemias; selective IgA deficiency; IgG subclass deficiency; common variable immunodeficiency; transient hypogammaglobulinaemia of infancy; selective specific antibody deficiencies)
- T lymphocyte deficiencies (Di George syndrome; Ommen's syndrome; bare lymphocyte syndrome; X-linked hyper IgM syndrome; severe T cell deficiencies (X-linked recessive form; adenosine deaminase (ADA) deficiency; purine nucleoside phosphorylase (PNP) deficiency)
- Combined T & B cell defects
    - Severe combined immunodeficiency (SCID) (autosomal recessive SCID; T cell receptor immunodeficiency; MHC Class II deficiency; IL-2 production defect)
    - Wiskott-Aldrich syndrome

- Secondary immunodeficiencies (iatrogenic; neoplasia; infection)
- Cytokine defects
- Human immunodeficiency virus (HIV) and AIDS
    - Pathogenesis of HIV infection
    - Epidemiology, prevalence and modes of transmission
    - Laboratory abnormalities in HIV infection
    - Management of HIV infection (drug therapies; vaccines)
- Immunotherapy
    - Antibodies as immunosuppressive agents (plasmapheresis and plasma exchange; monoclonal antibody therapy; generation of antibodies; “Magic bullet” therapy)
    - Immunosuppressive drugs (corticosteroids; cyclosporin and tacrolimus; other anti-inflammatory agents)
    - Other immunosuppression on (X-irradiation; ultraviolet light)
    - Cytokines and anti-cytokines (interleukin-1; interleukin-2; interferons; tumour necrosis factors (TNF); Th1/Th2 balance)
    - Immune modulation by intravenous immunoglobulins
    - Immune potentiation (hormones; cytokine therapy; gene therapy)
    - Other uses of monoclonal antibodies
    - Stress and the immune system (psycho-neuro-endocrino-immune pathway)
    - Immunisation against infection (adjuvants ; routine immunisations ; travel immunisations ; passive immunisation ; new vaccines)
    - Cancer immunotherapy
    - Novel approaches to autoimmune disease (T cell vaccines; oral tolerance)
    - Other approaches (lymphocyte vaccination; blocking T cell-adenomatous polyposis coli (APC) interactions; gene repair; patient specific amplification of cytotoxic cells; stem cell therapies)

6.2 Year 2 and 3 Research Project

Division:	**Life Sciences**
Theme:	**Blood Sciences**
Specialism:	**Clinical Immunology**
Year 2 and 3:	**CI-Res: Research Project in Clinical Immunology [60 Credits]**

The overall aim of this module, building on the Research Methods module is for the trainee to undertake research that shows originality in the application of knowledge, together with a practical understanding of how established techniques of research and enquiry are used to create and interpret new information in a specialism of healthcare science. During Years 2 and 3 the trainee will undertake an original piece of research involving the application of scientific investigation to one or more clinical situations.

The trainee will also be expected to complete three shorter health services research projects to gain an understanding of the health services contexts within which clinical research is undertaken.
One each in:

- Evidence-based practice
- Clinical audit
- Supporting professional service users

Learning Outcomes: Knowledge and Understanding

On successful completion of this module the trainee will:

1. Evaluate the basic scientific principles underpinning research.
2. Critically evaluate the principles and practice of evidence based medicine.
3. Explain and critically evaluate individual research publications according to evidence based medicine criteria.
4. Critically evaluate, analyse and summarise current research and advanced scholarship in the specialism and draw justified conclusions from the evidence.
5. Explain the current system of grading research publications.
6. Explain the use and limitations of reference manager systems.
7. Describe and appraise the process leading to publication of a research paper.
8. Describe the audit cycle and the importance of clinical audit in improving patient care, multidisciplinary working and in optimising laboratory medicine service provision.
9. Recognise the importance of innovation in healthcare science.

Learning Outcomes: Associated Work Based Practical Skills

On successful completion of this module the trainee will:

1. Establish the core skills necessary for scientific research in a clinical environment.
2. Develop and propose a hypothesis.
3. Undertake a research project to test the hypothesis from conception to completion.
4. Confirm the necessary ethical, audit and/or Research and Development (R&D) approval.
5. Assemble a body of data and analyse the data using appropriate statistical techniques.
6. Prepare a written project report that analyses the findings and identifies strengths and weaknesses of the research project.
7. Communicate knowledge or arguments from the research project both orally and in writing including presentation at a work based meeting.
8. Critically evaluate and draw conclusions about the quality of relevant research publications.
9. Contribute to and take an active part in the performance of a clinical audit that involves completion of the audit cycle.
10. Demonstrate the importance of multidisciplinary working in the design, delivery and optimisation of improved laboratory medicine services.

Learning Outcomes: Associated Personal Qualities and Behaviours

(**Professionalism)**

On successful completion of this module the trainee will:

1. Further develop critical analytical skills.
2. Evaluate and apply evidence.
3. Work within an ethical framework.
4. Work independently or as a member of a team.
5. Demonstrate effective time management and organisation.
6. Exercise initiative and personal responsibility.
7. Reflect on performance and seek help and advice when necessary.

Indicative Content

- Literature searching
- Principles and good practice examples of evidence based medicine
- The audit cycle and its good practice examples of its application to clinical audit as a means of service development
- Critical analysis
- Research project that may include:
    - Systematic review
    - Evaluation of new methodologies
    - Investigation to improve performance of a method
    - Evaluation of new/modified quality assurance of a method
    - Audit of method performance across a range of departments
    - Critical analysis of evidence-base underpinning a specified procedure
- Communications skills
- Report writing
- Presentational skills

6.3 Year 3 Specialist Practice

Division: **Life Sciences**
Theme: **Blood Sciences**
Specialism: **Clinical Immunology**
Year 3: **CI-4: Hypersensitivity and Allergy [10 Credits]**

This module will provide the trainee with knowledge and understanding of the mechanism of hypersensitivity and allergy. They will understand the clinical presentation and investigation of a range of conditions associated with hypersensitivity and allergy. They will become familiar with methods and strategies to investigate hypersensitivity and allergy and gain experience of the interpretation of patient results in a variety of clinical settings.

Learning Outcomes: Knowledge and Understanding

On successful completion of this module the trainee will:

1. Define and understand “atopy” and explain the factors involved in the

development of atopic disease.
2. Define and understand allergy and distinguish it from hypersensitivity.
3. Understand and distinguish the four types of hypersensitivity.
4. Understand the production of immunoglobulin E (IgE) by B cells in response to allergen.
5. Explain how IgE triggers mast cells to deregulate.
6. Describe the clinical features of mast cell degranulation in the allergic patient.
7. Understand the important features of allergic rhinitis, atopic eczema and anaphylaxis.
8. Describe the design, operation and performance of hypersensitivity skin testing including contraindications, limitations and precautions to be taken.
9. Describe the design, operation, use and limitations of immunology laboratory tests for specific IgE.
10. Understand the important causes of and explain the mechanism of allergic contact dermatitis.
11. Describe the partnership between the clinical immunology laboratory and other clinical specialisms in the investigation of hypersensitivity and allergy.

Learning Outcomes: Associated Work Based Learning

High level description of the work based learning that accompanies this academic module. Further details are contained within the work based training manual.

On successful completion of this module the trainee will:

1. Understand and demonstrate the ability to perform hypersensitivity testing and immunology laboratory tests for specific IgE.
2. Gain experience of the clinical and laboratory investigation of hypersensitivity and allergy including the interpretation and reporting of results in the correct clinical context.
3. Gain experience of the partnership between the clinical immunology laboratory and other clinical specialisms in the investigation of hypersensitivity and allergy.

Learning Outcomes: Associated Personal Qualities and Behaviours (Professionalism)

On successful completion of this module the trainee will, in the context of clinical immunology:

1. Present complex ideas in simple terms in both oral and written formats.
2. Consistently operate within sphere of personal competence and level of authority.
3. Manage personal workload and objectives to achieve quality of care.
4. Actively seek accurate and validated information from all available sources.
5. Select and apply appropriate analysis or assessment techniques and tools.

6. Evaluate a wide range of data to assist with judgements and decision making.
7. Conduct a suitable range of diagnostic, investigative or monitoring procedures with due care for the safety of self and others.
8. Report problems and take part in restorative action within quality control/assurance requirements to address poor performance.
9. Interpret data and convert into knowledge for use in the clinical context of individual and groups of patients.
10. Work in partnership with colleagues, other professionals, patients and their carers to maximise patient care.

Indicative Content

- Type I Immediate hypersensitivity
  - Pathogenesis
  - Allergic diseases (asthma; allergic rhinitis; allergic eczema; urticaria)
  - Anaphylaxis
  - Desensitisation
- Type II Antibody dependent cytotoxic hypersensitivity
  - Organ specific autoimmune diseases
  - Autoimmune cytopoenias
  - Haemolytic disease of the new born
- Type III Immune complex mediated hypersensitivity
  - Serum sickness
  - Allergic alveolitis
  - Lepromatous leprosy
  - Systemic lupus erythematosus (SLE)
  - Cutaneous vasculitis
  - Arthus reaction
- Type IV Delayed cell mediated hypersensitivity
  - Contact hypersensitivity
  - Tuberculous reactions
  - Granulomas
  - Graft rejection and graft versus host disease (GVHD)
- Type V Stimulatory hypersensitivity
  - Autoantibodies against cell receptors (thyroid stimulatory autoantibodies)

Division: Life Sciences
Theme: Blood Sciences
Specialism: Clinical Immunology
Year 3: CI-5: Haematological Malignancies and Transplantation [10 Credits]

This module will provide the trainee with knowledge and understanding of the pathophysiology, clinical presentation and management of patients with haematological malignancy. They will perform relevant laboratory methods and gain experience of the interpretation of patient results in a variety of clinical settings.

Learning Outcomes: Knowledge and Understanding

On successful completion of this module the trainee will:

1. Understand the classification, aetiology and genetics of haematological malignancy.
2. Describe the design, operation and performance of laboratory and molecular techniques used in the investigation and management of haematological malignancy.
3. Understand the principles of bone marrow and stem cell harvests and their role in transplantation programmes.
4. Understand the principles and mechanisms of chemotherapy, immunotherapy and radiotherapy and their use in haematological malignancy.
5. Understand the importance and implementation of national (e.g. NICE) guidance on the diagnosis and management of haematological cancer.
6. Understand the importance of integrated diagnosis of haematological malignancy.
7. Describe the partnership between the haematology laboratory and other clinical specialisms in the investigation of haematological malignancy.

Learning Outcomes: Associated Work Based Learning

High level description of the work based learning that accompanies this academic module. Further details are contained within the work based training manual.

On successful completion of this module the trainee will:

1. Understand and demonstrate the ability to perform the range of laboratory and molecular testing techniques used in the workplace to diagnose and monitor treatment of haematological malignancy.
2. Gain experience of the clinical and laboratory investigation and management of haematological malignancy including the interpretation and reporting of results in the correct clinical context.
3. Gain experience of the application of national and international guidance (e.g. NICE) on the diagnosis and management of haematological cancer.
4. Gain experience of the partnership between the haematology laboratory and other clinical specialisms in the investigation of haematological malignancy.

Learning Outcomes: Associated Personal Qualities and Behaviours (Professionalism)

On successful completion of this module the trainee will, in the context of haematology and transfusion science:

1. Present complex ideas in simple terms in both oral and written formats.
2. Consistently operate within sphere of personal competence and level of

authority.
3. Manage personal workload and objectives to achieve quality of care.
4. Actively seek accurate and validated information from all available sources.
5. Select and apply appropriate analysis or assessment techniques and tools.
6. Evaluate a wide range of data to assist with judgements and decision making.
7. Conduct a suitable range of diagnostic, investigative or monitoring procedures with due care for the safety of self and others.
8. Report problems and take part in restorative action within quality control/assurance requirements to address poor performance.
9. Interpret data and convert into knowledge for use in the clinical context of individual and groups of patients.
10. Work in partnership with colleagues, other professionals, patients and their carers to maximise patient care.

Indicative Content

Current concepts on the aetiology, pathogenesis and molecular mechanisms involved in

- Myeloid malignancy
- Lymphoid leukaemia
- Lymphoma
- Myeloma and plasma cell disorders
- Myelodysplastic syndromes
- Diagnosis and management of the above
- Myeloproliferative disorders and their diagnosis and management
- Bone marrow failure syndromes
- Blood and bone marrow transplantation regimes
- Principles of chemo- and radio-therapy and the rationale behind Medical Research Council (MRC) acute myeloid leukaemia (AML) and acute lymphoblastic leukaemia (ALL) trials
- Survival rates in haematological malignancy
- IQC and EQA in haemato-oncology
- BCSH guidelines in haemato-oncology; NICE improved outcome guidance

Division: **Life Sciences**
Theme: **Blood Sciences**
Specialism: **Clinical Immunology**
Year 3: **CI-6: Autoimmunity [10 Credits]**

This module will provide the trainee with knowledge and understanding of the mechanism of autoimmunity. They will understand the clinical presentation and investigation of a range of autoimmune disease. They will become familiar with methods and strategies to investigate autoimmunity and gain experience of the interpretation of patient results in a variety of clinical settings.

Learning Outcomes: Knowledge and Understanding

On successful completion of this module the trainee will:

1. Understand the causes of autoimmune disease.
2. Understand the strategies and methods to distinguish autoimmunity from autoimmune disease.
3. Understand the role of autoantibodies and autoimmune disease.
4. Understand the role of autoreactive T cells and autoimmune disease.
5. Understand the investigation and management of autoimmune disease.
6. Describe the design, operation and performance of laboratory techniques for the investigation of autoimmune disease.
7. Describe the partnership between clinical immunology and other clinical specialism in the investigation of autoimmune disease.

Learning Outcomes: Associated Work Based Learning

This provides a high level description of the work based learning that accompanies this academic module. Further details are contained within the work based training manual.

On successful completion of this module the trainee will:

1. Understand and demonstrate the ability to select and perform immunology tests for the diagnosis and management of a range of autoimmune diseases.
2. Gain experience of the clinical and laboratory investigation of a range of autoimmune diseases including the interpretation and reporting of results in the correct clinical context.
3. Gain experience of the use of the clinical and laboratory investigation of the immune system in pregnancy including the interpretation and reporting of results in the correct clinical context.
4. Gain experience of the partnership between clinical immunology and other clinical specialisms in the investigation of autoimmune disease.

Learning Outcomes: Associated Personal Qualities and Behaviours (Professionalism)

On successful completion of this module the trainee will, in the context of clinical immunology:

1. Present complex ideas in simple terms in both oral and written formats.
2. Consistently operate within sphere of personal competence and level of authority.
3. Manage personal workload and objectives to achieve quality of care.
4. Actively seek accurate and validated information from all available sources.
5. Select and apply appropriate analysis or assessment techniques and tools.
6. Evaluate a wide range of data to assist with judgements and decision making.
7. Conduct a suitable range of diagnostic, investigative or monitoring procedures with due care for the safety of self and others.

8. Report problems and take part in restorative action within quality control/assurance requirements to address poor performance.
9. Interpret data and convert into knowledge for use in the clinical context of individual and groups of patients.
10. Work in partnership with colleagues, other professionals, patients and their carers to maximise patient care.

Indicative Content

- Spectrum and overlap of autoimmune diseases (multifactorial; genetic factors; hormonal factors; environmental factors)
- Autoreactivity
    - Countering immune regulatory mechanisms
    - Pathogenic effects (autoantibodies; autoreactive cells; immune complexes)
    - Diagnostic tests
- Vasculitis
- Rheumatic and connective tissue diseases
- Endocrine autoimmune diseases
- Liver diseases
- Gastrointestinal diseases
- Renal diseases
- Skin Diseases
- Neurological diseases

6.4 Variation to Clinical Immunology Curriculum to Support the Training of Healthcare Scientists to Work in Histocompatibility and Immunogenetics

In order to better support the training of Healthcare Scientists for Histocompatibility and Immunogenetics (H&I) a variation to the Clinical Immunology curriculum is supported. This variation will be restricted to the two Specialist Practice modules in Year 2 of the curriculum:

- The module CI-2 entitled 'Immunity: Implications for Infection and for Cancer' is replaced by the module is replaced by the new module HI-2 entitled Histocompatibility

- The module CI-6 entitled 'Autoimmunity' is replaced by a new module HI-6 entitled 'Haemopoetic Stem Cell Transplantation'

These variations to Year 2 of the Curriculum are described below.

6.5 Year 2 Specialist Practice

Division:	**Life Sciences**
Theme:	**Blood Sciences**
Specialism:	**Clinical Immunology (Histocompatibility & Immunogenetics)**
Year 3:	**HI-2: Histocompatibility [10 Credits]**

This module will provide the trainee with knowledge and understanding of the scientific basis of organ transplantation. They will understand the clinical preparation of patients for organ transplantation and the principles and practice of immunogenetics. They will become familiar with methods that support transplantation and gain experience of the interpretation of patient results in a variety of clinical settings. The trainee should be based in or spend extended time in a histocompatibility and immunogenetics department.

Learning Outcomes: Knowledge and Understanding

On successful completion of this module the trainee will:

1. Understand the immunological barriers to solid organ and haemopoeitic stem cell transplantation.
2. Understand the mechanisms of graft rejection and the relevance of pre-sensitisation.
3. Understand the mechanisms of current immunosuppressive therapies in the control of graft rejection.
4. Understand and the role of the histocompatibility and immunogenetics laboratory in the pre transplant work up and post transplant management of patients.
5. Describe the design, operation and performance of appropriate laboratory tests in support of HLA antibody identification and definition, HLA typing and data analysis.
6. Describe the design, operation and performance of appropriate laboratory tests in support of crossmatching for solid organ transplantation.
7. Describe the partnership between the clinical immunology laboratory and other clinical specialisms in solid organ and immunogenetic transplantation.

Learning Outcomes: Associated Work Based Learning

High level description of the work based learning that accompanies this academic module. Further details are contained within the work based training manual.

On successful completion of this module the trainee will:

1. Understand and demonstrate the ability to select and perform laboratory tests for HLA antibody identification and definition, HLA typing and data analysis.
2. Understand and demonstrate the ability to select and perform laboratory tests in support of crossmatching for solid organ transplantation.

3. Gain experience of the clinical and laboratory work up of patients awaiting solid organ and haemopoetic stem cell transplantation including the interpretation and reporting of results in the correct clinical context.
4. Gain experience of the clinical and laboratory monitoring of patients who have received solid organ and immunogenetic stem cell transplantation including the interpretation and reporting of results in the correct clinical context.
5. Gain experience of the role of the histocompatibility and immunogenetics laboratory.
6. Gain experience of the partnership between the clinical immunology laboratory and other clinical specialisms in the investigation of solid organ and haemopoetic stem cell transplantation.

Learning Outcomes: Associated Personal Qualities and Behaviours (Professionalism)

On successful completion of this module the trainee will, in the context of clinical immunology:

1. Present complex ideas in simple terms in both oral and written formats.
2. Consistently operate within sphere of personal competence and level of authority.
3. Manage personal workload and objectives to achieve quality of care.
4. Actively seek accurate and validated information from all available sources.
5. Select and apply appropriate analysis or assessment techniques and tools.
6. Evaluate a wide range of data to assist with judgements and decision making.
7. Conduct a suitable range of diagnostic, investigative or monitoring procedures with due care for the safety of self and others.
8. Report problems and take part in restorative action within quality control/assurance requirements to address poor performance.
9. Interpret data and convert into knowledge for use in the clinical context of individual and groups of patients.
10. Work in partnership with colleagues, other professionals, patients and their carers to maximise patient care.

Indicative Content

- Histocompatibility antigens
    - Structure and function
    - Generation of polymorphism
    - Nomenclature
- Mechanisms of allograft rejection
    - Alloantigen recognition
    - Classification of rejection reactions
    - Graft-versus-host reactions
    - HLA typing
    - Pre-transplant sensitisation
- Immunosuppressive therapy
    - Drugs

- Biological modifiers
- NICE Recommendations
- Adverse effects of immunosuppressive therapies

- Clinical transplantation
  - Renal transplantation (selection of recipient and donor; post-transplantation period; clinical rejection; immunopathology of rejection; graft survival; complications)
  - Other types of organ transplantation (liver; heart; lung; pancreas; pancreatic islets: skin; cornea)
  - Haemopoietic stem cell transplantation (indications and selection of patients; donor – recipient matching requirements; management; complications and prevention; results and prognosis; sources of stem cells for transplantation; stem cell transplantation for non-malignant indications)

6.6 Year 3 Specialist Practice

Division:	**Life Sciences**
Theme:	**Blood Sciences**
Specialism:	**Clinical Immunology (Histocompatibility & Immunogenetics)**
Year 2:	**HI-6: Haemopoetic Stem Cell Transplantation (HSCT)**

This module will provide the trainee with a knowledge and understanding of stem cell donation, testing, harvesting, and monitoring. They will understand a range of clinical conditions associated with stem cell transplantation requirements. They will gain experience of HLA typing in the matching of donors and suitable recipients. They will perform relevant laboratory methods and gain experience of the interpretation of patient results in a variety of clinical settings.

Learning Outcomes: Knowledge and Understanding

On successful completion of this module the trainee will:

1. Demonstrate an understanding of the role of HSCT in the treatment of various haemopoeitic disorders.
2. Understand the nomenclature of the HLA system and its role in the selection of donors for HSCT.
3. Describe the design, operation and performance of HLA typing methods for HSCT according to current guidelines.
4. Understand the principles of post-transplant monitoring and its role in patient management.
5. Describe the partnership between histocompatibility & immunogenetics and other clinical specialisms in the investigation of HSCT.

Learning Outcomes: Associated Work Based Learning

High level description of the work based learning that accompanies this academic module. Further details are contained within the work based training manual.

On successful completion of this module the trainee will:

1. Understand and demonstrate the ability to select and perform HLA typing methods for haemopoetic stem cell transplantation according to current practice.
2. Gain experience of the clinical and laboratory investigation of patients being considered for HSCT including the interpretation and reporting of results in the correct clinical context.
3. Understand and demonstrate the ability to select and perform laboratory methods for post-transplant monitoring.
4. Gain experience of clinical and laboratory roles in post-transplant monitoring including the interpretation and reporting of results in the correct clinical context.
5. Gain experience of the partnership between histocompatibility & immunogenetics and other clinical specialisms in the investigation of haemopoetic stem cell transplantation.

Learning Outcomes: Associated Personal Qualities and Behaviours (Professionalism)

On successful completion of this module the trainee will, in the context of haematology and transfusion science:

1. Present complex ideas in simple terms in both oral and written formats.
2. Consistently operate within sphere of personal competence and level of authority.
3. Manage personal workload and objectives to achieve quality of care.
4. Actively seek accurate and validated information from all available sources.
5. Select and apply appropriate analysis or assessment techniques and tools.
6. Evaluate a wide range of data to assist with judgements and decision making.
7. Conduct a suitable range of diagnostic, investigative or monitoring procedures with due care for the safety of self and others.
8. Report problems and take part in restorative action within quality control/assurance requirements to address poor performance.
9. Interpret data and convert into knowledge for use in the clinical context of individual and groups of patients.
10. Work in partnership with colleagues, other professionals, patients and their carers to maximise patient care.

Indicative Content

- Principles of HSCT
- HLA genetics and nomenclature
- Stem cell sources
- Principles of donor selection
- Pre-transplant work-up
- Compatibility testing

- Stem cell registries –Bone Marrow Donors Worldwide (BMDW), Anthony Nolan Trust (ANT), Worldwide Network for Blood and Marrow Transplantation (NetCord)
- Principles of post transplant monitoring
- Graft vs Host disease and Graft vs Leukaemia
- Legislation:- Joint Accreditation Committee – ISCT & EBMT (JACIE), Human Tissue Authority (HTA), European Federation for immunogenetics (EFI), Foundation for the Accreditation of Cellular Therapy (FACT)

7.0 Specialist Modules for Genetics

	Module Titles			
Year 3	CG-4: Infertility and Disorders of Sexual Differentiation [10]	CG-5: Population Screening [10]	CG-6: Cancer [10]	CG-Res: Research Project in Genetics [30]
Year 2	Research Methods [10]	CG-2: Genetics of Learning Disorders [10]	CG-3: Genetics of Neuromuscular Disorders [10]	CG-Res: Research Project in Genetics [30]
Year 1	Healthcare Science - integrating science and professional practice [20]		Introduction to Blood Sciences - underpinning knowledge for rotational elements and integrated professional practice [40]	

Generic Modules: Common to all divisions of Healthcare Science

Division Specific/Theme Modules: Common to a division or theme

Specialist Modules: Specific to a specialism

7.1 Year 2 Specialist Practice

Division: **Life Sciences**
Theme: **Blood Sciences**
Specialism: **Genetics**
Year 2: **CG-2: Genetics of Learning Disorders [10 Credits]**

This module will provide the trainee with knowledge and understanding of the role and application of genetics testing in the diagnosis and management of patients with learning difficulties and the implications to other family members.

Learning Outcomes: Knowledge and Understanding

On successful completion of this module the trainee will:

1. Understand the clinical presentation and assessment of subjects with genetic causes of learning difficulties, including fragile X syndrome, Rett syndrome and Prader-Willi Syndrome/Angelman Syndrome (PWS/AS) as examples.
2. Understand the appropriate genetic laboratory testing strategy for subjects with learning difficulties.
3. Describe the design, operation and performance of genetics tests relevant to the investigation of learning difficulties.
4. Understand the implications of the genetic tests including ethical, legal and social implications for the effective management of the patients.
5. Describe the partnership between laboratory genetics and other clinical specialisms in the investigation of learning disorders.

Learning outcomes: Associated Work Based Learning

High level description of the work based learning that accompanies this academic module. Further details are contained within the work based training manual.

On successful completion of this module the trainee will:

1. Understand and demonstrate the ability to use a range of laboratory techniques to investigate the genetic basis of learning disorders including chromosome analysis, microarray analysis.
2. Gain experience of the clinical and laboratory investigation and management of patients with learning disorders such as fragile X syndrome, Rett syndrome and PWS/AS, including the interpretation and reporting of results in the correct clinical context.
3. Gain experience of the ethical, legal and social implications of the investigation of subjects with learning difficulties.
4. Gain experience of the partnership between laboratory genetics and other clinical specialisms in the investigation of learning disorders.

Learning Outcomes: Associated Personal Qualities and Behaviours (Professionalism)

On successful completion of this module the trainee will, in the context of genetics:

1. Present complex ideas in simple terms in both oral and written formats.
2. Consistently operate within sphere of personal competence and level of authority.
3. Manage personal workload and objectives to achieve quality of care.
4. Actively seek accurate and validated information from all available sources.
5. Select and apply appropriate analysis or assessment techniques and tools.
6. Evaluate a wide range of data to assist with judgements and decision making.
7. Conduct a suitable range of diagnostic, investigative or monitoring procedures with due care for the safety of self and others.
8. Report problems and take part in restorative action within quality control/assurance requirements to address poor performance.
9. Interpret data and convert into knowledge for use in the clinical context of individual and groups of patients.
10. Work in partnership with colleagues, other professionals, patients and their carers to maximise patient care.

Indicative Content

- The principal referral reasons which would indicate testing for each of the conditions under investigation.
- Blood sample processing to obtain chromosome preparations suitable for analysis and appropriate staining and banding techniques relevant to this referral group.
- Analysis of chromosomes from patients with learning disorders – use of ISCN.
- Interpretation of results from chromosome analysis using relevant on- line databases and search engines.
- Application of FISH for targeted microdeletion/duplication syndromes: technical processing and fluorescent microscopy.
- Assessment of suitability of DNA for microarray analysis.
- Microarray technical processing: labelling, hybridisation, scanning.
- Microarray data-analysis and using array-CGH software.
- Interpretation of the significance of Copy Number Variations (CNVs) using genome browsers and CNV databases and reporting using ISCN.
- Design of strategies for extended microarray follow-up using additional techniques.
- The clinical, scientific and molecular basis for the repertoire of genetic testing available to investigate the common range of clinical referrals for fragile X syndrome, Rett syndrome and PWS/AS syndrome.
- Interpretation of results from fluorescent PCR across the Fragile X mental retardation 1 (FMR1) gene in order to detect results within normal, intermediate and expanded ranges, and results, which are to be designated as failed analyses. Identification of samples which require repeating and/or which require Southern blotting.

- Interpretation of results from Southern blotting for the detection of large expansions and methylation status of alleles in Fragile X.
- Interpretation of results from multiplex ligation-dependent pulse amplification (MLPA) or bisulphite analysis for PWS/AS syndrome.
- Use of Southern blotting to detect methylation differences in PWS/AS syndromes.
- The basis on which variants identified in the methyl CpG binding protein 2 (MECP2) gene in Rett syndrome are classified according to their pathology.
- Applicability of non-routine investigations available to elucidate unusual results further (for example sequencing of FMR1 gene).
- The use of laboratory information management systems (LIMS) to access correct reporting templates.
- Significance of test results and interpretation in order to inform further testing to answer clinical questions.
- Sources of further information for extended testing in learning disability e.g. use of UK Genetics Testing Network (UKGTN) and Database of Chromosomal Imbalance and Phenotype in Humans using Ensembl resources (DECIPHER) databases to identify commissioned tests and where they could be undertaken.

Division:	**Life Sciences**
Theme:	**Blood Sciences**
Specialism:	**Genetics**
Year 2:	**CG-3: Genetics of Neuromuscular Disorders [10 Credits]**

This module will provide the trainee with knowledge and understanding of the role and application of genetic testing in the diagnosis and management of patients with neurological and muscular disorders and the implications for other family members.

Learning Outcomes: Knowledge and Understanding

On successful completion of this module the trainee will:

1. Understand the clinical presentation and assessment of subjects with genetic causes of neurological and muscular disorders, including Huntington disease, Duchenne and Becker muscular dystrophies, myotonic dystrophy, spinal muscular atrophy, Charcot-Marie-Tooth, and mitochondrial myopathies.
2. Understand the appropriate genetic laboratory testing strategy for subjects with neurological and muscular disorders.
3. Describe the design, operation and performance of genetics tests relevant to the investigation of neurological and muscular disorders
4. Understand the implications of the genetic tests including ethical, legal and social implications for the effective management of the patients and their relatives.
5. Describe the partnership between laboratory genetics and other clinical specialisms in the investigation of neurological and muscular disorders.

Learning Outcomes: Associated Work Based Learning

High level description of the work based earning that accompanies this academic module. Further details are contained within the work based training manual.

On successful completion of this module the trainee will:

1. Understand and demonstrate the ability to use a range of laboratory techniques to investigate the genetic basis of neurological and muscular disorders including triplet repeat analysis and quantitative PCR techniques.
2. Gain experience of the clinical and laboratory investigation and management of patients with neurological and muscle disorders, such as Huntington disease (HD), myotonic dystrophy (DM), Charcot-Marie-Tooth disease (CMT), and Duchenne and Becker muscular dystrophies (B/DMD), including the correct interpretation and reporting of results in the clinical context.
3. Gain experience of the ethical, legal and social implications of the investigation of subjects with neurological and muscle disorders
4. Demonstrate the ability to use appropriate equipment, size standards, controls, and statistical analysis software, to interpret and report a range of testing appropriate to neurological and muscle disorders.
5. Gain experience of the partnership between laboratory genetics and other clinical specialisms in the investigation of neurological and muscular disorders.

Learning Outcomes: Associated Personal Qualities and Behaviours (Professionalism)

On successful completion of this module the trainee will, in the context of genetics:

1. Present complex ideas in simple terms in both oral and written formats.
2. Consistently operate within sphere of personal competence and level of authority.
3. Manage personal workload and objectives to achieve quality of care.
4. Actively seek accurate and validated information from all available sources.
5. Select and apply appropriate analysis or assessment techniques and tools
6. Evaluate a wide range of data to assist with judgements and decision making.
7. Conduct a suitable range of diagnostic, investigative or monitoring procedures with due care for the safety of self and others.
8. Report problems and take part in restorative action within quality control/assurance requirements to address poor performance.
9. Interpret data and convert into knowledge for use in the clinical context of individual and groups of patients.
10. Work in partnership with colleagues, other professionals, patients and their carers to maximise patient care.

Indicative Content

- Clinical presentation and assessment of subjects with neurological and muscle disorders
- The types of inheritance displayed by Huntington disease, myotonic dystrophy, Duchenne and Becker muscular dystrophies, Charcot-Marie-Tooth disease, spinal muscular atrophy, and mitochondrial myopathies
- The clinical, scientific, and molecular basis for the repertoire of genetic testing available to investigate the common range of referrals for Huntington disease, myotonic dystrophy, Duchenne and Becker muscular dystrophies, Charcot-Marie-Tooth disease, spinal muscular atrophy, and mitochondrial myopathies
- The technical basis of genetic tests used to identify large triplet repeats (e.g. triplet repeat primed PCR (TP-PCR), Southern blot hybridisation).
- The technical basis of tests used to identify mitochondrial mutations.
- The tissues used to test for mitochondrial myopathies (e.g. blood, urine, muscle)
- The technical basis and interpretation of tests used to identify large deletions and duplications (e.g. MLPA)
- Relationship between particular genetic abnormalities and phenotype (e.g. Duchenne v Becker muscular dystrophy, and spinal muscular atrophy types I, II, and III, CMT1A v hereditary neuropathy with liability to pressure palsies)
- Understanding the mechanisms of pathogenesis in neurological and muscular disorders
- Understanding the importance of heteroplasmy in mitochondrial myopathies and its effect on phenotype
- Diagnostic and prognostic significance of genetic abnormalities found in this group of patients
- The importance of counselling, e.g., in predictive testing of late onset disorders such as Huntington's disease and the importance of distinguishing between diagnostic and predictive test requests
- Understand the use and limitations of linkage analysis for B/DMD, spinal muscular atrophy (SMA), and HD
- Understand the basis of risk calculations used for carrier risk assessment for B/DMD and SMA
- Understand the importance of appropriate internal and external quality control

7.2 Year 2 and 3 Research Project

Division:	**Life Sciences**
Theme:	**Blood Sciences**
Specialism:	**Genetics**
Year 2 and 3:	**CG-Res: Research Project in Genetics [60 Credits]**

The overall aim of this module, building on the Research Methods module is for the trainee to undertake research that shows originality in the application of knowledge, together with a practical understanding of how established

techniques of research and enquiry are used to create and interpret new information in a specialism of healthcare science. During Years 2 and 3 the trainee will undertake an original piece of research involving the application of scientific investigation to one or more clinical situations.

The trainee will also be expected to complete three shorter health services research projects to gain an understanding of the health services contexts within which clinical research is undertaken.

One each in:

- Evidence-based practice
- Clinical audit
- Supporting professional service users

Learning Outcomes: Knowledge and Understanding

On successful completion of this module the trainee will:

1. Evaluate the basic scientific principles underpinning research.
2. Critically evaluate the principles and practice of evidence based medicine.
3. Explain and critically evaluate individual research publications according to evidence based medicine criteria.
4. Critically evaluate, analyse and summarise current research and advanced scholarship in the specialism and draw justified conclusions from the evidence.
5. Explain the current system of grading research publications.
6. Explain the use and limitations of reference manager systems.
7. Describe and appraise the process leading to publication of a research paper.
8. Describe the audit cycle and the importance of clinical audit in improving patient care, multidisciplinary working and in optimising laboratory medicine service provision.
9. Recognise the importance of innovation in healthcare science.

Learning Outcomes: Associated Work Based Practical Skills

On successful completion of this module the trainee will:

1. Establish the core skills necessary for scientific research in a clinical environment.
2. Develop and propose a hypothesis.
3. Undertake a research project to test the hypothesis from conception to completion.
4. Confirm the necessary ethical, audit and/or Research and Development (R&D) approval.
5. Assemble a body of data and analyse the data using appropriate statistical techniques.
6. Prepare a written project report that analyses the findings and identifies strengths and weaknesses of the research project.

7. Communicate knowledge or arguments from the research project both orally and in writing including presentation at a work based meeting.
8. Critically evaluate and draw conclusions about the quality of relevant research publications.
9. Contribute to and take an active part in the performance of a clinical audit that involves completion of the audit cycle.
10. Demonstrate the importance of multidisciplinary working in the design, delivery and optimisation of improved laboratory medicine services.

Learning Outcomes: Associated Personal Qualities and Behaviours (Professionalism)

On successful completion of this module the trainee will:

1. Further develop critical analytical skills.
2. Evaluate and apply evidence.
3. Work within an ethical framework.
4. Work independently or as a member of a team.
5. Demonstrate effective time management and organisation.
6. Exercise initiative and personal responsibility.

Indicative Content

- Literature searching
- Principles and good practice examples of evidence based medicine
- The audit cycle and its good practice examples of its application to clinical audit as a means of service development
- Critical analysis
- Research project that may include:
  - Systematic review
  - Evaluation of new methodologies
  - Investigation to improve performance of a method
  - Evaluation of new/modified quality assurance of a method
  - Audit of method performance across a range of departments
  - Critical analysis of evidence-base underpinning a specified procedure
- Communications skills
- Report writing
- Presentation skills

7.3 Year 3 Specialist Practice

Division:	**Life Sciences**
Theme:	**Blood Sciences**
Specialism:	**Genetics**
Year 3:	**CG-4: Infertility and Disorders of Sexual Differentiation [10 Credits]**

This module will provide the trainee with knowledge and understanding of the role and application of genetics testing in the diagnosis and management of

patients with infertility and disorders of sexual differentiation and the implications to other family members.

Learning Outcomes: Knowledge and Understanding

On successful completion of this module the trainee will:

1. Understand the clinical presentation and assessment of subjects with disorders of sexual differentiation and genetic causes of infertility.
2. Understand the appropriate genetic laboratory testing strategy for subjects with disorders of sexual differentiation and infertility.
3. Describe the design, operation and performance of a range of genetic testing relevant to infertility and disorders of sexual differentiation, including chromosome analysis, CF testing, Y deletion screening, androgen receptor mutation analysis, Fragile X (FRAXA) testing in premature ovarian failure (POF).
4. Understand the implications of the genetic tests including ethical, legal and social implications for the effective management of patients with disorders of sexual differentiation and infertility.
5. Describe the partnership between laboratory genetics and other clinical specialisms in the investigation of disorders of sexual differentiation and infertility.

Learning Outcomes: Associated Work Based Learning

High level description of the work based learning that accompanies this academic module. Further details are contained within the work based training manual.

On successful completion of this module the trainee will:

1. Understand and demonstrate the ability to perform a range of laboratory techniques to investigate disorders of sexual differentiation and genetic causes of infertility, including CF testing, FRAXA and chromosome analysis.
2. Gain experience of the clinical and laboratory investigation and management of patients with disorders of sexual differentiation and genetic causes of infertility, including the interpretation and reporting of results in the correct clinical context.
3. Demonstrate the ability to interpret and report a range of genetic testing relevant to infertility and disorders of sexual differentiation including abnormal results from chromosome constitution, CF, Y deletion, androgen receptor, POF, sex reversal.
4. Gain experience of the ethical, legal and social implications of the investigation of subjects with disorders of sexual differentiation and genetic causes of infertility.
5. Gain experience of the partnership between laboratory genetics and other clinical specialisms in the investigation of disorders of sexual differentiation and genetic causes of infertility.

Learning Outcomes: Associated Personal Qualities and Behaviours (Professionalism)

On successful completion of this module the trainee will, in the context of genetics:

1. Present complex ideas in simple terms in both oral and written formats.
2. Consistently operate within sphere of personal competence and level of authority.
3. Manage personal workload and objectives to achieve quality of care.
4. Actively seek accurate and validated information from all available sources.
5. Select and apply appropriate analysis or assessment techniques and tools.
6. Evaluate a wide range of data to assist with judgements and decision making.
7. Conduct a suitable range of diagnostic, investigative or monitoring procedures with due care for the safety of self and others.
8. Report problems and take part in restorative action within quality control/assurance requirements to address poor performance.
9. Interpret data and convert into knowledge for use in the clinical context of individual and groups of patients.
10. Work in partnership with colleagues, other professionals, patients and their carers to maximise patient care.

Indicative Content

- Clinical presentation and assessment of subjects with disorders of sexual differentiation and genetic causes of infertility
- Review of testing strategies appropriate to this group of referrals and relevant patient pathways
- Recognise problems associated with genetic mosaicism in testing this group of patients.
- Relevant laboratory techniques used to identify genomic abnormalities in this group of patients
- The technical basis of the major genetic tests (e.g. amplification refractory mutation system (ARMS) and oligonucleotide ligation assay (OLA)) to detect cystic fibrosis transmembrane conductance regulator (CFTR) mutations including intron 8 polyT tract variants
- The technical basis of detecting FRAXA premutation alleles in POF referrals by PCR and Southern blot analysis
- Comparative advantages and disadvantages of each method for detecting FRAXA premutations
- Relationships between particular genetic abnormalities and their influence on phenotype
- Diagnostic and prognostic significance of genetic abnormalities found in this group of patients
- Recognise and understand this type of genetic testing in relation to other clinical referrals and laboratory investigations

Division: Life Sciences
Theme: Blood Sciences
Specialism: Genetics
Year 3: CG-5: Population Screening [10 Credits]

This module will provide the trainee with knowledge and understanding of the role and application of genetic testing in population screening and the associated diagnosis and management of patients.

Learning Outcomes: Knowledge and Understanding

On successful completion of this module the trainee will:

1. Understand the clinical, scientific, ethical and social requirements to introduce a new population screening programme based on genetic testing.
2. Understand the organisation, delivery and performance of national screening programmes including prenatal screening, sickle cell/ thalassaemia, cystic fibrosis (CF), phenylketonuria (PKU), medium-chain acyl-coenzyme A dehydrogenase deficiency (MCAD), Down syndrome screening, and familial hypercholesterolaemia (FH) screening. Understand appropriate follow up in screening programme positive cases, including ultrasound scan (USS) and non-invasive prenatal diagnosis.
3. Describe the design, operation and performance of a range of genetic testing relevant to population screening, including quantitative fluorescent PCR (QF-PCR) and interphase FISH for trisomy detection, high resolution analysis of chromosomes and targeted mutation analysis.
4. Describe the partnership between laboratory genetics and other clinical specialisms in the introduction, reporting and follow up of population screening programmes.

Learning Outcomes: Associated Work Based Learning

High level description of the work based learning that accompanies this academic module. Further details are contained within the work based training manual.

On successful completion of this module the trainee will:

1. Understand and demonstrate the ability to perform a range of genetic laboratory techniques appropriate to population screening, including QF-PCR and interphase FISH for trisomy detection, high resolution analysis of chromosomes and targeted mutation analysis.
2. Gain experience of the clinical and laboratory performance of population screening programmes including the interpretation and reporting of results in the correct clinical context.
3. Demonstrate the ability to interpret and report a range of genetics testing relevant to the effective management of the patient, in relation to the national screening programmes and public health.

4. Gain experience of the ethical, legal and social implications of national screening programmes.
5. Gain experience of the partnership between laboratory genetics and other clinical specialisms in the conduct, interpretation and follow up of population screening programmes.

Learning Outcomes: Associated Personal Qualities and Behaviours (Professionalism)

On successful completion of this module the trainee will, in the context of genetics:

1. Present complex ideas in simple terms in both oral and written formats.
2. Consistently operate within sphere of personal competence and level of authority.
3. Manage personal workload and objectives to achieve quality of care.
4. Actively seek accurate and validated information from all available sources.
5. Select and apply appropriate analysis or assessment techniques and tools.
6. Evaluate a wide range of data to assist with judgements and decision making.
7. Conduct a suitable range of diagnostic, investigative or monitoring procedures with due care for the safety of self and others.
8. Report problems and take part in restorative action within quality control/assurance requirements to address poor performance.
9. Interpret data and convert into knowledge for use in the clinical context of individual and groups of patients.
10. Work in partnership with colleagues, other professionals, patients and their carers to maximise patient care.

Indicative Content

- The clinical, scientific, ethical and social requirements to introduce a new population screening programme based on genetic testing
- The organisation, delivery and performance of national screening programmes including prenatal screening, sickle cell/ thalassaemia, CF, PKU, MCAD, Down syndrome screening, and FH. Appropriate follow up in screening programme positive cases, including USS and non-invasive prenatal diagnosis
- Targeted mutation testing and aneuploidy testing without generating unwanted information
- Best practice guidelines when involved in a complex and/or tightly defined care pathway
- Principles and practice of QF-PCR used for aneuploidy detection and in relation to other uses of this technology
- Nature and effect of structural chromosome rearrangements in relation to QF-PCR testing
- Nature and effect of possible artefacts related to QF-PCR
- The nature and effect of mosaicism, maternal cell contamination, twin pregnancies in relation to QF-PCR testing

- Procedures for confirmation of abnormal QF-PCR results
- Principles and practise of interphase FISH and the utility of FISH vs QF-PCR
- Association of Clinical Cytogeneticists (ACC) /Clinical Molecular Genetics Society (CMGS) Best Practice Guidelines relevant to analysis of QF-PCR for diagnosis of aneuploidy
- Utility of high resolution chromosome analysis / array analysis following abnormal USS
- Methods of targeted mutation analysis and their use in screening protocols such as ARMs, OLA, pyrosequencing
- The integration of targeted mutation analysis associated with screening protocols with genetic testing for the same disease in other care pathways
- The role of genetic testing in the screening programmes, the information that is required to deliver the screening outcomes and therefore the content of the report
- The clinical implications of any of the results from the range of genetic tests

Division: **Life Sciences**
Theme: **Blood Sciences**
Specialism: **Genetics**
Year 3: **CG-6: Cancer [10 Credits]**

This module will provide the trainee with knowledge and understanding of role and application of genetic testing in the diagnosis and management of patients with acquired and inherited cancer and the implications to other family members.

Learning Outcomes: Knowledge and Understanding

On successful completion of this module the trainee will:

1. Understand the clinical presentation and assessment of subjects with cancers associated with known genetic variation.
2. Understand appropriate testing strategies for acquired and inherited cancers, such as breast cancer (BRCA), hereditary nonpolyposis colorectal cancer (HNPCC), CML, ALL including molecular pathology, emerging bio-markers and methylation including risk assessment.
3. Describe the design, operation and performance of a range of genetic testing relevant to cancer, including mutation scanning and sequencing of large genes such as the inherited cancer genes, FISH for the detection of cancer fusion genes, quantitation, and chromosome analysis of leukaemia.
4. Understand the implications of the genetic tests including ethical, legal and social implications for the effective diagnosis and prognostic management of patients with cancer.
5. Describe the partnership between laboratory genetics and other clinical specialisms in the investigation of cancer.

Learning Outcomes: Associated Work Based Learning

High level description of the work based learning that accompanies this academic module. Further details are contained within the work based training manual.

On successful completion of this module the trainee will:

1. Understand and demonstrate the ability to perform a range of genetic laboratory techniques appropriate to cancer, including mutation scanning and sequencing of large genes such as the inherited cancer genes, FISH for the detection of cancer fusion genes, quantitation, and chromosome analysis of leukaemia.
2. Gain experience of testing strategies for acquired and inherited cancers, such as BRCA, HNPCC, CML, ALL including molecular pathology, emerging bio-markers and methylation including risk assessment, including the interpretation and reporting of results in the correct clinical context.
3. Demonstrate the ability to interpret and report a range of genetic testing relevant to cancer including acquired and inherited, predictive testing, pedigree analysis, BRCA, HNPCC, molecular pathology and bio-markers.
4. Gain experience of the ethical, legal and social implications of the investigation of subjects with cancer.
5. Gain experience of the partnership between laboratory genetics and other clinical specialisms in the investigation of disorders of cancer.

Learning Outcomes: Associated Personal Qualities and Behaviours (Professionalism)

On successful completion of this module the trainee will, in the context of genetics:

1. Present complex ideas in simple terms in both oral and written formats.
2. Consistently operate within sphere of personal competence and level of authority.
3. Manage personal workload and objectives to achieve quality of care.
4. Actively seek accurate and validated information from all available sources.
5. Select and apply appropriate analysis or assessment techniques and tools.
6. Evaluate a wide range of data to assist with judgements and decision making.
7. Conduct a suitable range of diagnostic, investigative or monitoring procedures with due care for the safety of self and others.
8. Report problems and take part in restorative action within quality control/assurance requirements to address poor performance.
9. Interpret data and convert into knowledge for use in the clinical context of individual and groups of patients.
10. Work in partnership with colleagues, other professionals, patients and their carers to maximise patient care.

Indicative Content

- Clinical presentation and assessment of subjects with cancers associated with known genetic variation.
- Clinical care pathways associated with the samples tested in cancer and the principles of cost effectiveness.
- Ethical issues associated with consent including predictive testing.
- Basis of inherited predispositions to cancer using examples of two diseases such as BRCA, familial adenomatous polyposis (FAP) or HNPCC.
- Principles of pedigree analysis and the calculation of risk.
- Principles and practice associated with predictive testing in inherited cancer syndromes.
- Principles underpinning at least two methods of mutation scanning including sequencing.
- Genetic causes of sporadic cancer such as sporadic bowel cancer, the gene pathways involved and their relation to inherited disease.
- Gene structure and the range of mutations seen in an exemplar large gene.
- Different methodologies that can be used to identify different classes of mutation.
- The scientific and mathematical basis of quantitation using standard curves, regression analysis and relevant software.
- Use of biomarkers such as somatic mutations such as those found in Kirsten rat sarcoma viral oncogene homolog (KRAS) in the management and treatment of cancer.
- Basis upon which variants identified in the germline are classified according to their pathology.
- Utility of genetic testing in generating prognostic information in the management of cancer e.g. common chromosomal rearrangements.
- Utility of genetic testing in monitoring the efficacy of treatment in cancer e.g. CML, Breast cancer.
- Role of managerial processes such as multidisciplinary team (MDT) meetings and guidelines such as Improving Outcomes Guidance and NICE Guidelines.
- Relationship between chromosome abnormalities and oncogenes and an understanding of the relationships between chromosome abnormality and the molecular biology of cancer.
- Role of cytogenetics in bone marrow transplantations.
- Role of molecular analysis in the diagnosis and monitoring of leukaemias.
- Mixed cell populations seen in cancer and how the testing strategy has to be developed and refined if required to enhance the population of abnormal cells.
- Principles of FISH in identification of rearrangements associated with cancer.
- Principles underpinning at least one method in quantitation of residual disease e.g. CML, ALL.
- Rearrangements and translocations commonly associated with cancer, their clinical significance and the methods used to detect them.
- Other methods used in the diagnosis of leukaemias (i.e. haematology, morphology, immunology).

Section B: Generic Curriculum

Professional Practice

Within the Scientist Training Programme (STP) the generic curriculum contains two modules namely Healthcare Science and Research Methods. Professional Practice is also generic across the 3-year STP programme and it is intended that the learning outcomes with respect to Professional Practice will be delivered within the workplace and MSc.

Generic Outcomes: Professional Practice
Integrated theme running from Year 1 to Year 3

The overall aim of this part of the curriculum is to ensure that the trainee has the underpinning knowledge and gains the accompanying skills and attitudes to work as a Healthcare Scientist.

Learning Outcomes: Knowledge and Understanding

On successful completion of this module the trainee will:

1. Know the current structure, management, legal framework and quality improvement structures and processes within the NHS.
2. Discuss patient centred care to ensure that the wishes, beliefs, concerns, expectations and needs of patients are respected.
3. Recognise the patient and carer perspective with respect to illness, the diversity of the patient experience, disability, potential health inequalities, the importance of self-care and the impact of life threatening and critical conditions.
4. Discuss the importance of developing and maintaining appropriate patient-professional relationships.
5. Explain the principles of effective communication including written, verbal and non-verbal communication and feedback.
6. Discuss the principles, guidance and law with respect to medical ethics, confidentiality, informed consent, equality and diversity, child protection and the use of chaperones.
7. Describe local guidelines for responding to unacceptable behaviour by patients, carers, relatives, peers and colleagues including harassment, bullying and violent behaviour.
8. Discuss best practice requirements for record keeping and data security emphasising accurate recording within patient records.
9. Explain the basic principles of infection control and the importance of current infection control measures within the workplace.
10. Explain the principles of screening programmes in healthcare and is aware of a current screening programmes in a relevant division.
11. Explain the importance of health and safety with the workplace, the regulations and current procedures with respect to equipment safety.
12. Define Standard Operating Procedure, Protocol and Guideline and understand the purpose of and difference between each document.

13. Explain the processes for document distribution for example Medical Device Alerts (MDA).
14. Explain the common causes of error, the critical incident reporting process and the importance of a no blame culture.
15. Recognise the importance of correctly identifying patients referred to healthcare science settings and/or samples sent for analysis.
16. Explain the importance of innovation across healthcare science and the role of innovation in improving quality and patient care.
17. Recognise the role of the healthcare scientist and the potential impact of scientific developments for example health prevention, genomic medicine, diagnostics and rehabilitation.
18. Understand the importance of public engagement in science and its role in health and society.
19. Know and understand the underpinning principles of effective team work and working within and across professional boundaries.
20. Explain the core theories of learning particularly adult learning and reflective practice.

<u>Clinical Examination Skills</u>

20. Describe the process of patient centred interviewing and the features of a good consultation.
21. Know how information from a history and examination is used to develop clinical management plans.

<u>Leadership</u>

22. Explain how effective leadership can underpin the delivery of high quality services, an organisation's aspiration and strategy and in developing improvements to services.
23. Discuss personal values, principles and assumptions, understanding how these may differ from those of other individuals and groups and learn from experience.
24. Explain the importance of the concept of shared leadership and the associated personal qualities and behaviours that promote shared leadership.
25. Know how planning can actively contribute to the achievement of service goals.

Learning Outcomes Associated Personal Qualities/Behaviours (Professionalism)

On successful completion of this module the trainee will:

1. Demonstrate practice that places the patient at the centre of care dealing with patients in an empathic and sensitive manner that promotes patient well-being and self-care.
2. Establish and maintain appropriate patient-professional partnership.
3. Communicate effectively and sensitively with patients, relatives and carers across the age spectrum utilising clear explanations/descriptions.
4. Communicate succinctly and effectively with other professionals as appropriate and the public including the ability to explain science to both

specialist and non-specialist audiences.
5. Demonstrate the ability to give effective feedback to colleagues and patients.
6. Contribute to service and quality improvement and productivity in the workplace.
7. Recognises the need for, and accepts change working across different provider landscapes as required.
8. Develop and demonstrate self awareness, self management and self development acting with integrity at all times.
9. Demonstrate accurate record keeping and the ability to adhere to current data security regulations.
10. Apply appropriately the principles, guidance and laws regarding equality and diversity, medical ethics, confidentiality and informed consent.
11. Apply current regulations with respect to patient safety and safe systems within the workplace including child protection and the use of chaperones.
12. Work within teams encouraging and valuing contributions from all members whilst ensuring the team are aware of and work together to minimise risk including the multi-disciplinary team.
13. Develop and maintain professional relationships and networks
14. Demonstrate adherence to current infection control regulations at all times.
15. Demonstrate adherence to the regulations and current procedures in place with respect to equipment safety.
16. Recognise the causes of error and learn from them, realising the importance of honesty and effective apology.
17. Recognise the desirability of monitoring performance, learning from mistakes and adopting no blame culture in order to ensure high standards of care and optimise patient safety.
18. Prioritise and organise academic and work based tasks in order to optimise own work and the work of the department and act autonomously in planning and implementing tasks at a professional level.
19. Develop skills of an independent learner and demonstrates a commitment to continuing professional development.
20. Demonstrate self-direction and originality in tackling and solving problems including dealing with complex issues, making sound judgements in the absence of complete data.
21. Identify best practice and emerging trends and innovation that will have an impact on health outcomes
22. Continue to advance personal knowledge and understanding applying skills of reflection to continually improve performance, acknowledging and acting on feedback.

<u>Clinical Examination Skills</u>

23. Demonstrate the ability to take a history and present the findings to a peer or colleague including initiation of a consultation, eliciting information, clarifying where necessary, summarising and empathising.
24. Give and receive feedback sensitively to or from a peer or colleague.
25. Perform a range of clinical examination skills relevant to the healthcare science specialism.

<u>Leadership</u>

26. Identify personal strengths and limitations and the impact of personal behaviour on others.
27. Identify personal emotions and prejudices and understand how these can affect personal judgement and behaviour.
28. Obtain, analyse and act on feedback from a variety of sources.
29. Use evidence, both positive and negative, to identify options.

Indicative Content

- Structure and management of health and social care services
- Management of local healthcare systems in the United Kingdom
- Legal framework within which healthcare is provided across the UK including its devolved administrations
- Local healthcare systems
- Patient centred care
    - Response to illness
    - Patient and carer perspective
    - Health belief models
    - Diversity of the patient experience
    - Disability including learning disabilities
    - Potential health inequalities
    - Self-care
- Impact of life threatening and critical conditions
- Patient-professional partnership.
- Effective Communication Skills
    - Principles and underpinning models for:
        - Written
        - Verbal
        - Non-verbal communication
        - Giving and receiving feedback from patients and colleagues
        - Breaking bad news
        - Negotiation
        - Communication within patients across the age spectrum
- Principles, guidance and law with respect to:
    - Medical ethics
    - Confidentiality
    - Informed consent
    - Equality and diversity
    - Child protection
    - Use of chaperones
    - Elder abuse.
- Local guidelines for responding to unacceptable behaviour
- Record Keeping and data security
    - Best practice requirements for record keeping
    - Data security
    - Accurate recording within patient records
    - Data protection act
    - Caldicott standards
- Clinical information systems
    - Clinical coding/terminology

    - Clinical information systems and applications
- Infection control
    - Basic principles
    - Current infection control measures within the workplace
    - Hand washing
- Screening
    - What is screening?
    - When is a screening programme justified?
    - How is screening organised?
    - Which screening programmes currently exist and which may be developed?
- Health and safety within the workplace
    - Regulations and current procedures with respect to equipment safety
        - Safety testing
    - Importance of regulations with respect to patient safety, safety of 3rd parties and safe systems
    - Standard operating procedures
    - Protocol and guidelines
    - Department of Health (DH) Central Alerting System (CAS)
    - Common causes of error
- Critical incident reporting
- Processes for document distribution
    - Department of Health (DH) Central Alerting System (CAS),
    - Medical Device Alerts (MDA)
- Public engagement in science and its role in health and society
- Effective team work
- Time management and decision making
- Core theories of learning
    - Adult learning
    - Active Learning
    - Reflective practice.
- Recognise and accept the responsibilities and roles of the Healthcare Scientist
    - In relation to other healthcare professionals
    - Working within and across professional boundaries
    - Health and well being.

<u>Clinical Examination Skills</u>

- Typical structures used in patient-centred history taking and clinical examination
- Listening skills
- Commonly used questioning techniques.
- Clinical management plans

<u>Leadership:</u>

- Demonstrating personal qualities
    - Self awareness
    - Managing yourself

    - Continuing professional development
    - Acting with integrity
- Working with others
    - Developing networks
    - Building & maintaining relationships
    - Encouraging contribution
    - Working within teams
- Managing services
- Improving services
- Setting direction

Appendix 1

Members of the Curriculum Development Group and Curriculum Reference Group

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Contributing Professional Bodies
Association for Clinical Biochemistry
Association for Clinical Biochemistry (Clinical Immunology)
Association for Clinical Cytogenetics
British Association for Tissue Banking
British Blood Transfusion Society
British Society for Haematology
British Society for Haemostasis and Thrombosis
British Society for Histocompatibility & Immunogenetics
British Toxicological Society
Clinical Molecular Genetics Society
Institute of Biomedical Science
Royal College of Pathologists
UK National External Quality Assessment Schemes

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Appendix 2

MSc Clinical Sciences (Blood Sciences) Learning Outcomes and Indicative Content 2010 - 11

Amendments - February 2012

The Association for Clinical Biochemistry (Clinical Immunology) requested that the following changes were made to the 2010 / 11 edition of the Clinical Immunology year 2 specialism sections of the MSc Clinical Sciences (Blood Sciences) curriculum. The MSC team have made the changes requested by the professional body, detailed below and re-issued this curriculum as MSc Clinical Sciences (Blood Sciences) 2010 - 11 v2 (see footer).

Page 56 section 6.1 Year 2 Specialist Practice for Clinical Immunology

Year 2: C1-2: Immunity: Implications for Infection, for Cancer and for Pregnancy

Clinical Immunology does not deal specifically with pregnancy and therefore

- The learning outcomes in the Knowledge and Understanding and Associated work based curriculum have been revised. All learning outcomes associated with pregnancy have been removed.
- The title of the Module has been updated and is now Year 2: C1-2: Immunity: Implications for Infection and for Cancer

Page 59 section 6.1 Year 2 Specialist Practice for Clinical Immunology

Year 2: C1-3: Autoimmunity

Clinical Immunology does not deal specifically with pregnancy and therefore

- The learning outcomes in the Knowledge and Understanding and Associated work based curriculum have been revised. All learning outcomes associated with pregnancy have been removed.

All other content in this curriculum remains unchanged.

The amended version is titled MSc Blood Sciences 2010-11 v2 (see footer).

For any queries regarding this change please email: mscenquiries@dh.gsi.gov.uk

Amendments - November 2012

The Association for Clinical Biochemistry (Clinical Immunology) and the British Society for Histocompatibility and Immunogenetics jointly requested that the following changes were made to the 2010 / 11 edition of the Clinical Immunology and the Histocompatibility & Immunogenetics Year 2 and 3 specialism sections of the MSc Clinical Sciences (Blood Sciences) curriculum. The MSC team have made the changes requested by the professional bodies, detailed below in this updated version of the curriculum as MSc Clinical Sciences (Blood Sciences) 2010 - 11 version 3 (see footer).

The changes result from experience of using the 2010-11 curriculum. It was agreed by both professional bodies that the original content of the curriculum did not adequately reflect the latest learning in transplantation that is required by trainees in this in Clinical Immunology and Histocompatibility and Immunogenetics. In outline the changes comprise:

1. The preparation of a new module that is common to both curricula and which replaces two different modules (one from each curriculum)
2. The change of title for one module in the Histocompatibility and Immunogenetics curriculum
3. A change of order of the modules to ensure that the three common modules are at the same stage in each of the two curricula

The detailed changes are given below. The changes to the Clinical Immunology curriculum carry into the Histocompatibility and Immunogenetics curriculum except where indicated. For clarity all Clinical Immunology modules have been coded ‘CI’ and all Histocompatibility and Immunogenetics modules have been coded ‘HI’. Commonality between the two curricula is maintained with modules CI-3/HI-3; CI-4/HI-4; and CI-5/HI-5 being identical.

Clinical Immunology Curriculum

Page 58 section 6.1 Year 2 Specialist Practice for Clinical Immunology

The module entitled ‘Immunodeficiency and Immunotherapy’ has been renumbered as CI-3 (previously CI-5). The earlier introduction of this module into the curriculum is seen as a sensible move.

Page 66 section 6.3 Year 3 Specialist Practice for Clinical Immunology

The new module CI-5 entitled ‘Haematological Malignancy and Transplantation’ has been introduced as a replacement for the previous module CI-6 entitled ‘Transplantation’. This better reflects the work of trainees in supporting the investigation and treatment of haematological malignancy.

Page 68 section 6.3 Year 3 Specialist Practice for Clinical Immunology

The module entitled ‘Autoimmunity’ has been renumbered as CI-6 (previously CI-3). This is a standalone module and there is no difficulty in re-positioning it as the final specialist module for Clinical Immunology.

Histocompatibility & Immunogenetics Curriculum

Page 71 section 6.5 Year 2 Specialist Practice for Histocompatibility and Immunogenetics

Module HI-2 has been re-named 'Histocompatibility' and given a new number. This module was previously CI-6 and entitled 'Transplantation'. The module has been removed from the Clinical Immunology curriculum (see above). The module focuses on histocompatibility and so it is appropriate to be the first specialist module in the Histocompatibility & Immunogenetics variation to the Clinical Immunology curriculum.

Page 73 section 6.6 Year 3 Specialist Practice for Histocompatibility and Immunogenetics

The new module HI-5 entitled 'Haematological Malignancy and Transplantation' has been introduced as a replacement for the previous module HT-2 entitled 'Clinical Haematology' (shared with the Haematology and Transfusion curriculum).This better reflects the work of trainees in supporting the investigation and treatment of haematological malignancy.

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The module entitled 'Haemopoetic Stem Cell Transplantation' has been renumbered HI-6 (previously CI-3B). Re-positioning this specialist module after the common module CI-5/HI-5 is appropriate.

The table below gives a summary of the revised modules.

Revised Modules for Clinical Immunology and Histocompatibility & Immunogenetics

Module	Clinical Immunology Module Title	Module	Histocompatibility & Immunogenetics Module Title
CI-1	Immunity and the Principles and Practice of Clinical Immunology	HI-1	Immunity and the Principles and Practice of Clinical Immunology
CI-2	Immunity: Implications for Infection and Cancer	HI-2	Histocompatibility
CI-3	Immunodeficiency & Immunotherapy	HI-3	Immunodeficiency & Immunotherapy
CI-4	Hypersensitivity & Allergy	HI-4	Hypersensitivity & Allergy
CI-5	Haematological Malignancy & Transplantation	HI-5	Haematological Malignancy & Transplantation
CI-6	Autoimmunity	HI-6	Haemopoetic Stem Cell Transplantation

For any queries regarding this change please email: mscenquiries@dh.gsi.gov.uk